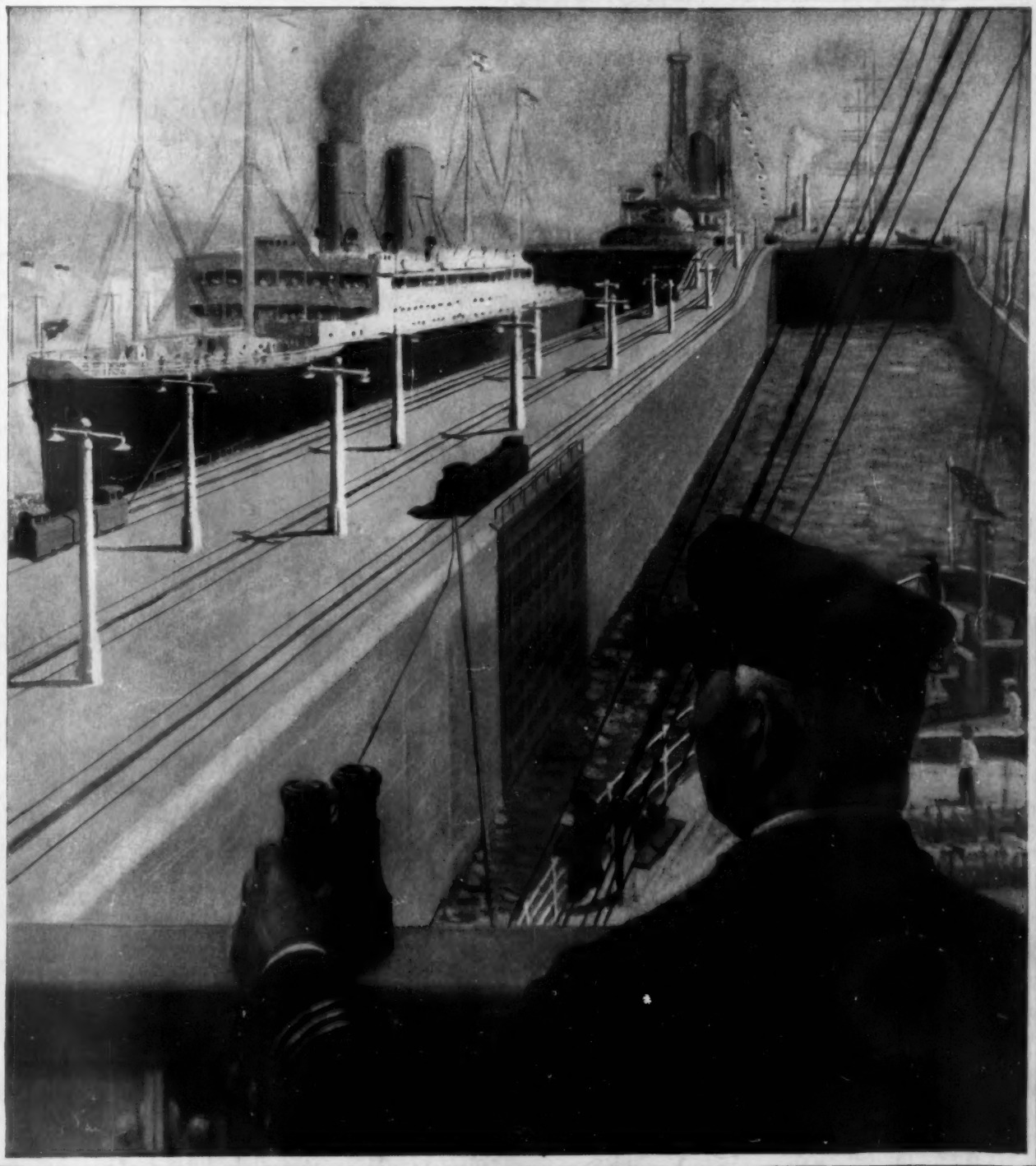
SCIENTIFIC AMERICAN



Problem of the Navy—II. Sea Power and Our Foreign Policies

The Navigating Lights of the Canal

How the Lock Gates of Panama will be worked

Vol. CX. No. 10
March 7, 1914

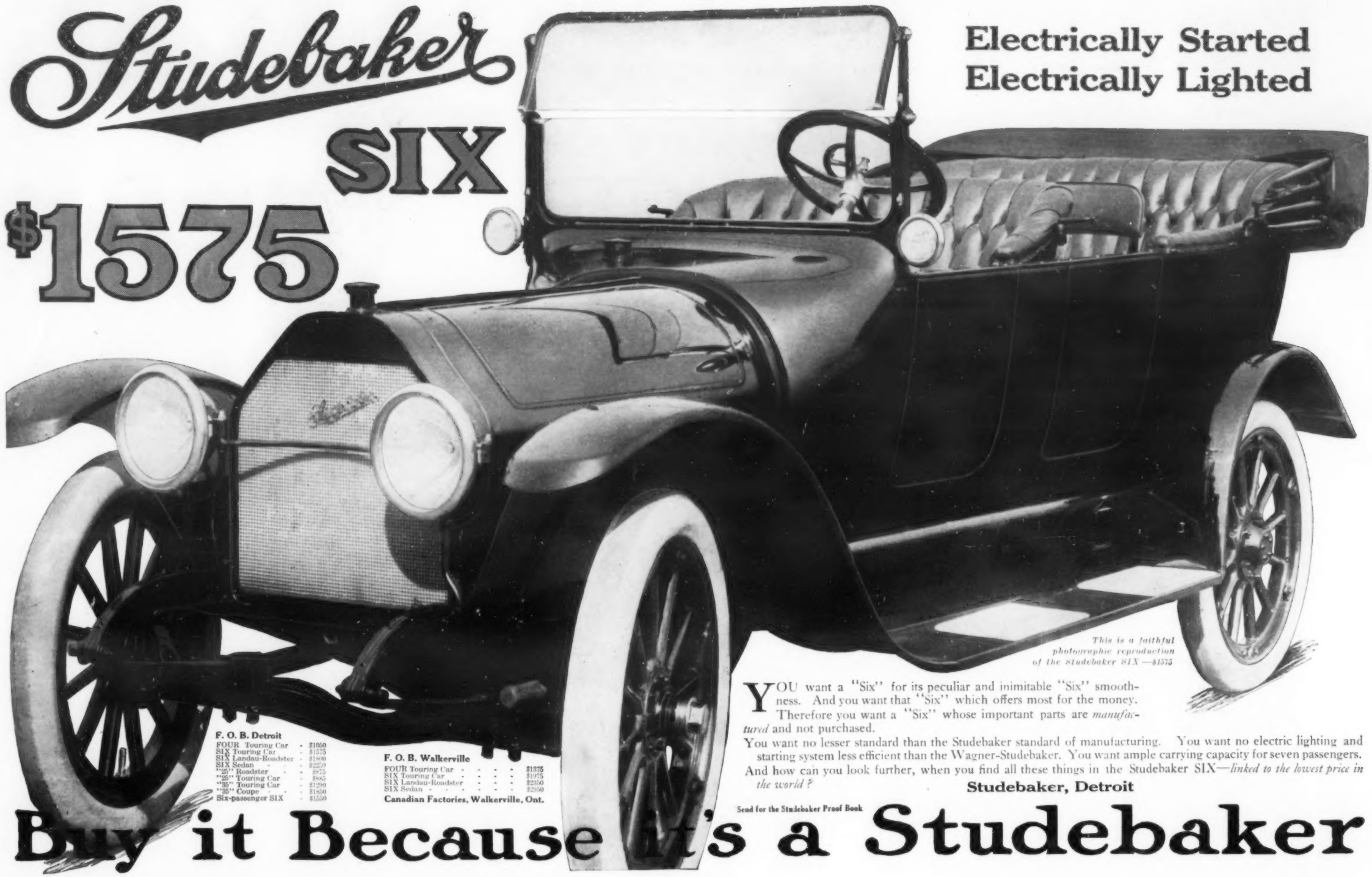
Munn & Co., Inc., Publishers
New York, N. Y.

Price 15 Cents
$3.00 A Year

Studebaker SIX

$1575

Electrically Started
Electrically Lighted



This is a faithful photographic reproduction of the Studebaker SIX —$1575

F. O. B. Detroit	
FOUR Touring Car	$1050
SIX Touring Car	$1575
SIX Landau-Roadster	$1800
SIX Sedan	$2250
"25" Roadster	$875
"25" Touring Car	$885
"35" Touring Car	$1250
"35" Coupe	$1850
Six-passenger SIX	$1550

F. O. B. Walkerville	
FOUR Touring Car	$1375
SIX Touring Car	$1975
SIX Landau-Roadster	$2350
SIX Sedan	$2350

Canadian Factories, Walkerville, Ont.

YOU want a "Six" for its peculiar and inimitable "Six" smoothness. And you want that "Six" which offers most for the money. Therefore you want a "Six" whose important parts are *manufactured* and not purchased.

You want no lesser standard than the Studebaker standard of manufacturing. You want no electric lighting and starting system less efficient than the Wagner-Studebaker. You want ample carrying capacity for seven passengers.

And how can you look further, when you find all these things in the Studebaker SIX—*linked to the lowest price in the world?*

Studebaker, Detroit

Send for the Studebaker Proof Book

Buy it Because it's a Studebaker

A Million Dollars In a Week

A thousand cars in seven days—a million dollars' worth of Jeffery Fours and Sixes sold in a week — that is the record established by the Jeffery organization at the Chicago show.

One hundred and thirty-eight cars were sold for immediate delivery. Dealers' orders were taken for one thousand and seventeen for delivery before April first.

Seven thousand dealers' orders have been taken to date. This number exceeds the possible production of the big Jeffery works for five months to come. It means that in March, April, May and June, Jeffery cars will be hard to get.

The public now knows that the Jeffery Four leads the medium priced field. It is now simply a question of factory production and deliveries.

Fifteen hundred and thirty-nine people registered for demonstrations during the Chicago Show. Manufacturers of other cars, salesmen interested in other lines and dealers selling all cars came to see the Jeffery — all conceded the Jeffery Four at $1550 to be without competition.

A buyer stepped into the exhibit of a five thousand dollar car near us. He said, "What do you think of this Jeffery over here?" The salesman replied, "I think so well of it that I told a friend of mine—who cannot pay our price—to go and buy a Jeffery."

Thirty cars a day are being produced in the Jeffery works. Think what it means to build that number of cars in the Jeffery way.

Fifty-six Jeffery Fours and Sixes were shipped by the factory on a day when a blizzard was raging through the country. The Jeffery pay roll today is the largest in the history of the company. The shipments for January exceeded by one hundred per cent those of January one year ago. February beat the same month last year by two hundred per cent.

A great period of prosperity is opening up in this country and the big Jeffery organization, with the new Jeffery Four and Six, is on the wave.

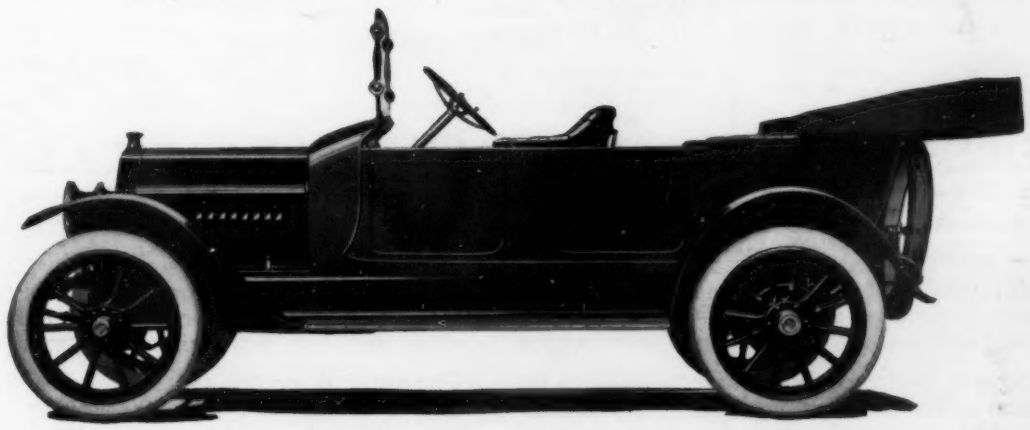
There are reasons for this prosperity. Here they are:

The Jeffery Four is the first light weight, high grade car, equipped with a modern European type of high speed bloc-type motor, to sell in this country for less than $2500.

Take it from the tip of the radiator to the tail lamp and there is quality in every detail. Bosch Duplex system, Rayfield carburetor, electric starting and lighting system, four speed transmission, imported annular ball bearings, Spicer universals, full floating type rear axle with imported annular ball bearings, Rothschild body, and quick getaway—from nothing to forty miles in twenty seconds.

In 1916 the Jeffery type of car will be more common. The great demand for light weight and economy is forcing other manufacturers to imitate us. The day of the big, bulky car is gone and the Jeffery car is the car of the hour because—

It's Economy Year, and Jeffery Made It So



Jeffery Four

Two passenger Four	$1550
Five passenger Four	1550
Four passenger Sedan Four	2350
Limousine Four	3000
Two passenger All-Weather Car	1950

Jeffery Six

Two passenger Six	$2250
Five passenger Six	2250
Six passenger Six	2300
Five passenger Sedan Six	3250
Limousine Six	3700

The Thomas B. Jeffery Company

Main Office and Works, Kenosha, Wisconsin

Chalmers

The Master "Six" $2175

Motor Folks call me the Master Six.

I have earned the title. I have set a new record for sixes. In one month alone men paid over $2,000,000 for me. They had all the sixes of the world to choose from. They chose me.

But first they made me prove myself. They put me to tests equal to a season's service. Only by living up to every claim did I win them.

Because I told my story in deeds rather than words—they were convinced, for they couldn't deny what their eyes saw—what their senses perceived.

Let me tell you in deeds the story of my master motor. It will win you as it won them.

The Turning of the Tide

Swiftly and surely the tide has turned to the Sixes. Motorists no longer are content with a power that lets go and grabs again at every other revolution. They now insist upon that quiet, steady pull, that luxurious smoothness that can come only from six cylinders.

Until the Master Six appeared last year, buyers had thought of all Sixes as heavy cars, extravagant of fuel and tires; costly to buy and expensive to keep. But the Master Six opened their eyes.

Here was a car of six cylinders at a moderate price, and even lighter than many 'fours' of equal power. Here was a motor so silent and smooth running that friction and wear might be forgotten. A car which costs little to buy and little to keep.

Power Lithe as a Panther

Its master motor has six cylinders of long stroke and small bore. So it fairly floats up the hills on high gear. It can reach twenty-five miles an hour in ten seconds from a standstill. It can creep like a snail through the crowd and then be off like a greyhound at the touch of the throttle.

This ability to run fast or slow on direct drive, to vary the speed at will without constantly shifting gears, puts the Master Six head and shoulders above its rivals. It gives a flexibility of power that is possible only among Sixes—and rare even there.

Vibration is Power Thrown Away

Vibration is wasteful as well as uncomfortable. It is power and fuel thrown away in joggling the car which should be used in propelling it. It throws useless strain upon bearings and tires. It means discomfort for the passengers, and increased fuel bills. It means the very life of the car cut short.

And vibration can't be cured by a makeshift. The only escape from it is in a six cylinder motor; where the impulses overlap; where the flow of the power stream is continuous.

The easy gliding motion of the Chalmers Six is like a caress. You who have never driven a real Six know nothing of its charm.

A One Motion Starter—A Non-Stallable Motor

One swing of a switch at the outset—and this is what happens. The Chalmers-Entz electric starter spins the engine to start it.

But that isn't all. If some unusual demand upon the engine should cause it to falter, the starter keeps it running until it picks up again.

There's no chance to be stranded in a throng or on a dangerous crossing. It makes the motor unstallable. In simplicity and sureness, the Chalmers-Entz system is without a parallel.

The Test That Tells the Tale

The true measure of value—and the only one—is performance. What will the car do in service? —that's the question.

So we have arranged the Chalmers Road Test. We make our appeal for the Chalmers Sixes through the cars themselves. We submit the evidence of deeds rather than of words.

Make this test—it is more than just a ride. Put the burden of proof on the car itself. It can't conceal; it can't exaggerate. It will give you a new standard by which to judge other cars.

The Master "Light Six" $1800

I am the Chalmers Light Six.

The son of a king—the Master Six.

I am like my illustrious sire though built in a lighter mould. I have speed—more than you'll need. Though my master motor is light I have power to spare. Light on my feet, I am saving on tires and frugal with fuel. I am easy to buy and easy to keep.

Six-Cylinder Value—Four-Cylinder Price

Many have waited for this day to come. They want a car of low first cost; yet a car of generous size and ample power. A light car, but not a little one. But this car must be a Six. For they know that means a car easy to ride in, easy to run, and easy to keep. In the Master Light Six everything has been reduced to the simplest form, yet nothing essential has been omitted. It gives the luxury and economy of the Six at the price of a "Four."

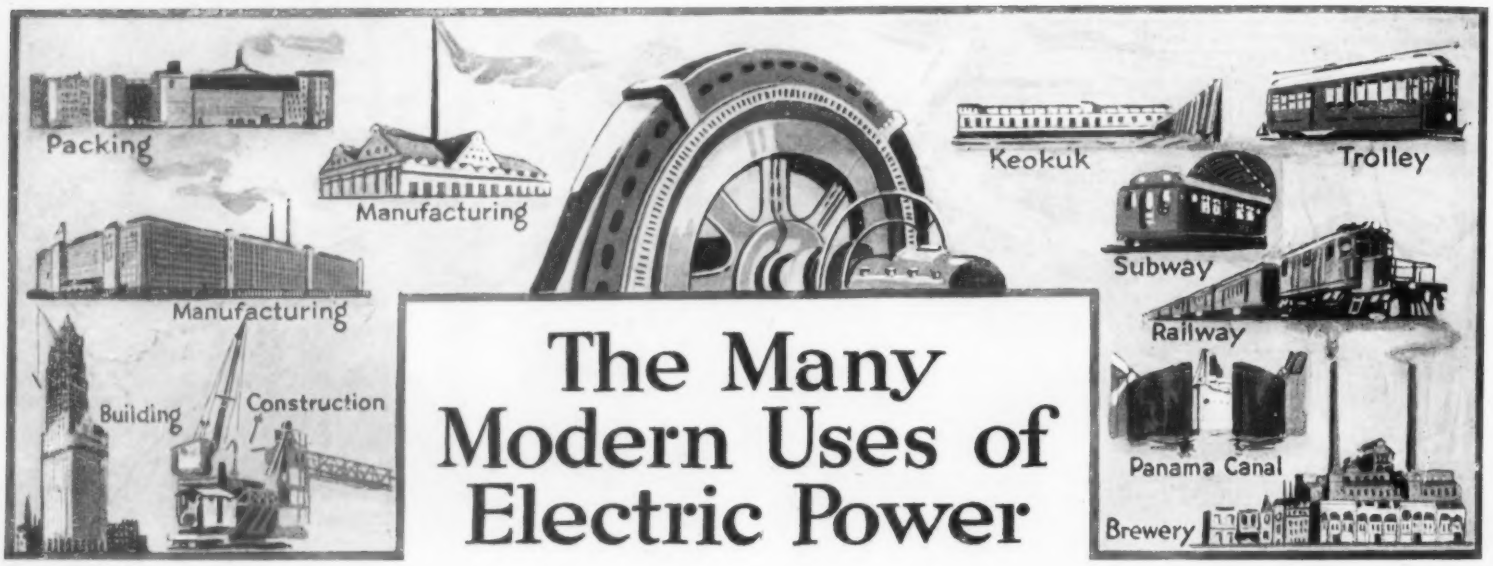
Safety First Always

When you ride in the light Six you can trust it. Frame and axles are of heat treated steel with a four fold margin of safety. Gears and roller bearings have withstood a crushing test of fifty tons. Its brakes will stop it within its length. Its electric starter prevents the motor from going dead at a critical moment. The gears lock themselves in mesh. The shifting device won't let you go wrong. The assurance of safety is the corner stone of motor pleasure.

Look at these features and try to match them at the price

Six Cylinders	126-inch Wheel Base
Molded Oval Fenders	Electric Starter
Non-Stallable Motor	Clean Running Board
Electric Lights	Tungsten Steel Valves
Triple Heated Fuel	Left-hand Drive
Timken Roller Bearings	Center Control
Locked Transmission Gears	34-inch Wheels
Chalmers Sectional Piston Rings	Rayfield Carburetor
Multiple Disc Clutch	Invisible Hinges
Underslung Springs	Streamline Body
48 Horsepower	Tapered Bonnet

Chalmers Motor Company, Detroit



The Many Modern Uses of Electric Power

FROM one end to the other of this busy country electricity has been demonstrating its pre-eminence as the smoother and the booster of business. In large manufacturing plants and small, in production centers of an immense variety, in public works and private enterprises—in every situation where POWER is needed—electricity has been proving its twentieth century utility. It has increased light and good cheer by eliminating line shafting and substituting individual motor drive. It has reduced fire dangers and insurance rates, and accident danger to workmen. It has promoted cleanliness. It has reduced power costs and proved its economy in related ways by simplifying operation, eliminating complexities in labor.

The Curtis Turbine has become a strong factor in power generation and the great range of G-E Motors has enabled these splendidly modern devices to meet all the intricate requirements of power transmission today. The partial list on this page will suggest the remarkable scope of usefulness in G-E apparatus.

Amoskeag Mfg. Co.
Manchester, N. H.—Largest cotton mill in the world—produces 60 miles of woven cloth an hour—uses G-E Motors throughout.

Anheuser Busch Brewing Co.
St. Louis. Mo.—G-E Motor drive is used extensively in this well known brewery.

Buick Automobile Co.
Flint, Mich.—When operating at full capacity this plant can produce a car a minute. G-E Motors used of course.

Cascade Tunnel,
Great Northern R. R.—G-E *Electric* Locomotives haul the trains through this famous tunnel.

Catskill Aqueduct,
New York City's water supply—practically all the electrical equipment used in constructing this famous aqueduct was furnished by the General Electric Company.

Great Southern Lumber Co.
Bogalusa, La.—Largest lumber mill in the world uses G-E Motors exclusively.

Indiana Steel Company,
Gary, Ind.—Hundreds of thousands of horse power from G-E Motors in this largest steel mill in the world.

Mississippi River Power Co.
Keokuk, Iowa—Largest power generating equipment in the world—G-E Electrical equipment throughout.

New York City Traffic—
No steam locomotives are allowed on Manhattan Island. G-E Electrical equipment is used by the N. Y. Central, the Interboro Elevated and the Hudson and Manhattan Tubes.

The Guarantee of Excellence on Goods Electrical
GE
Trade Mark

Panama Canal—
G-E Motors have helped to build and will operate the finished canal.

"Round the World"
—Every year the General Electric Company puts out enough railway motors to operate an electric belt line around the world.

Universal Portland Cement Co.
Buffington, Ind.—Operated by power furnished by G-E Motors.

Warner Sugar Refinery Company,
Edgewater, N. J.—Uses G-E Motor power extensively for all operations in connection with the refining of sugar.

Wood Worsted Mill—
American Woolen Company, Lawrence, Mass.—G-E Motors used throughout this largest Worsted Mill in the world.

Woolworth Building,
New York City—Highest office building in the world erected by G-E Motor-driven hoists.

GENERAL ELECTRIC COMPANY

Largest Electrical Manufacturer in the World

Atlanta, Ga.	Chattanooga, Tenn.	Elmira, N. Y.	Keokuk, Iowa	Memphis, Tenn.	Omaha, Neb.	St. Louis, Mo.
Baltimore, Md.	Chicago, Ill.	Erie, Pa.	Knoxville, Tenn.	Milwaukee, Wis.	Philadelphia, Pa.	Schenectady, N. Y.
Birmingham, Ala.	Cincinnati, Ohio	Fort Wayne, Ind.	Los Angeles, Cal.	Minneapolis, Minn.	Pittsburg, Pa.	Seattle, Wash.
Boise, Idaho	Cleveland, Ohio	Hartford, Conn.	Louisville, Ky.	Nashville, Tenn.	Portland, Ore.	Spokane, Wash.
Boston, Mass.	Columbus, Ohio	Indianapolis, Ind.	Madison, Wis.	New Haven, Conn.	Providence, R. I.	Springfield, Mass.
Buffalo, N. Y.	Davenport, Iowa	Jacksonville, Fla.	Mattoon, Ill.	New Orleans, La.	Richmond, Va.	Syracuse, N. Y.
Butte, Mont.	Dayton, Ohio	Joplin, Mo.	Niagara Falls, N. Y.	New York, N. Y.	Rochester, N. Y.	Toledo, Ohio.
Charleston, W. Va.	Denver, Colo.	Kansas City, Mo.		Salt Lake City, Utah	Washington, D. C.	
Charlotte, N. C.	Detroit, Mich. (Office of Agt.)			San Francisco, Cal.	Youngstown, Ohio.	

For Texas, Oklahoma and Arizona business refer to Southwest General Electric Company (formerly Hobson Electric Co.)—Dallas, El Paso, Houston and Oklahoma City.
For Canadian business refer to Canadian General Electric Company, Lt'd, Toronto, Ont.

4304

SEVENTIETH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CX. NUMBER 10.] NEW YORK, MARCH 7, 1914. [15 CENTS A COPY $3.00 A YEAR

Fig. 1.—A waterspout located out in the ocean, about eight miles from Beaufort, N. C. The spout is almost vertical.

Fig. 2.—The same waterspout, its inclination being less vertical. The altitude of this meteor is two thousand feet.

Waterspouts

THE accompanying photographs show a waterspout observed near Beaufort, N. C., in the early part of August, 1911. It was one of four or five seen on the same afternoon in the same general region. At one time three of these rather rare phenomena were in view at once, but when the pictures were taken the two smaller ones had broken.

As nearly as could be ascertained, the base of the spout was located out in the ocean some six or eight miles from Beaufort. Its height, which was calculated from the size of the photographs taken with an eight-inch (focal length) lens at an estimated distance of six miles, was about 2,000 feet. It remained in view for nearly half an hour and, before it finally disappeared, nearly the entire population of the city had assembled at the water's edge to see the remarkable sight.

According to the fishermen, waterspouts are not uncommon during the late summer, but they very rarely assume the immense size of this one or have its sharply defined outlines. It is still more unusual for one to remain so long unbroken.

The day on which the observations were made was not different, perceptibly, from other summer days until late in the afternoon, when very heavy storm clouds began to gather in the west. They moved slowly eastward, and, when they had come to cover about three fourths of the western sky, a slender waterspout was seen in the far distance, looking like a column of smoke from some factory chimney. It broke soon after it was first seen.

It was next noticed that a pencil of cloud much nearer at hand, was gradually extending itself downward. Its progress was very slow, and at times it became so attenuated that it seemed to consist of separated pieces. As it approached the water it became slightly thickened, and when it finally appeared to reach the surface of the ocean, its outlines became sharply defined. A great cloud of vapor surrounded the foot and large masses, looking like the steam puffed out by a locomotive, slowly traveled upward to be lost in the tumbling mass of clouds at the upper end of the spout. The upper end was of considerably greater diameter than the middle of the column, but there was very little evidence of the violent rotary motion or the swift rush across the water that the books usually describe. A slow swaying of the column from side to side was all that could be noticed. A closer view, however, would doubtless have shown that the rotary and progressive movements were very rapid. At times the column would become very tenuous, but the next minute would again become thick and dark. After about twenty minutes had elapsed it gradually became thinner and thinner, broke, and the upper third was slowly drawn upward while the lower part was dissipated by the wind. A heavy rain followed almost immediately.

Many popular delusions prevail on the subject of waterspouts; as, for example, the belief that they are actual columns of water, sucked up from the sea, and that they may be dissipated by firing a cannon ball through them. These and other errors were fully discussed in the SCIENTIFIC AMERICAN of June 10th, 1911, page 564.

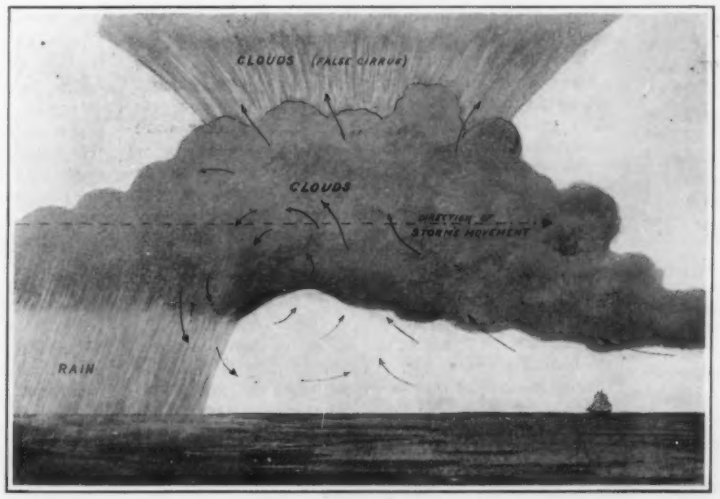


Fig. 3.—Cross-section of a thundersquall (after Arrhenius), showing the circulation of the air currents about a horizontal axis. According to Wegener, if the end of the whirl assumes a more or less vertical position it constitutes a "spout." A violent "spout" on land is a tornado.

When a French or German writer has occasion to refer to the class of atmospheric whirls to which belong the waterspout, landspout, and tornado, he calls them by the convenient generic name *trombes* (French) or *tromben* (German). The equivalent English word "spout," which was in common use in this sense a hundred years ago, is now so rare that a writer hesitates to use it, without an explanatory note. The French word *trombe* has often been borrowed by English writers, but is hardly in current use. The revival of the word "spout" in scientific and general literature is a desideratum.

Dr. Alfred Wegener of Marburg has recently published in the *Meteorologische Zeitschrift* a novel hypothesis as to the origin of spouts. The fact that these whirls begin in the upper air, and are not primarily due to conditions prevailing at the earth's surface, has long been known to meteorologists, though inaccurate statements on this subject are commonly met with in *soi-disant* scientific literature. There is no indraft of the lower air from all sides, as in a cyclonic storm; the spout works downward from the clouds, and if it extends as far as the surface of the land or the sea it disturbs the air over only a small horizontal area just below it.

Dr. Wegener believes that the spout is always merely the attendant of a thundersquall; i. e., an atmospheric whirl on an elongated horizontal axis. The end of such a whirl is, according to this view, sometimes tilted downward until it reaches the earth, constituting a spout. It is pointed out that the axes of spouts are usually inclined at a considerable angle, rather than vertical. Even when the position of the axis approaches the vertical, it is often seen to be inclined in its upper portion toward the neighboring thunderstorm, a physical connection with which is thus suggested.

There are few trustworthy observations of the direction in which the air rotates in a spout. Inspection of the *débris* left by a tornado furnishes the only satisfactory evidence on this subject, and on this basis it has generally been believed that there was no constant rule for the rotation of a spout, as there is for that of a cyclone. As the wind in a thunderstorm blows outward from the front of the storm at the ground, curves upward, and finally blows back into the storm to complete its circuit, if Dr. Wegener's hypothesis is correct, the direction of the spout's rotation will depend upon whether the spout is formed at the left or the right side of the thunderstorm. In the northern hemisphere spouts will usually form on the left side of thunderstorms. The right-hand deflection of the winds with ascent causes the storm to build itself toward the right and die out to the left; but a vortex, instead of participating in the bodily movement of the latter, is left behind as the storm shifts sideways.

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Munn & Co., Inc., 361 Broadway, New York

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Extensions of the Food and Drugs Act

ONCE upon a time the histrionic exhibition of candor on the part of a certain soap-making concern which announced that its product was only "99½ per cent pure" attracted considerably more attention than far more damnatory confessions of the same nature do to-day.

The Food and Drugs Act in these United States, and analogous legislation in other countries have wrought a remarkable revolution in the attitude of the public toward many things that were once regarded as "impurities" and "adulterants," and were accordingly in strong disfavor. Artificial coloring matter, preservatives, and the like have been to a certain extent robbed of their terrors. But the end is not yet. The last report of the United States Bureau of Chemistry traces the operation of two recent amendments to the Food and Drugs Act, which not only are significant in themselves, but open up new vistas to the student of practical ethics. The Sherley amendment, enacted August 23rd, 1912, deals with medicines branded with false and fraudulent statements concerning their effects on disease. Hundreds of these preparations have been analyzed by the chemists of the Bureau. As a result seizure of several preparations was recommended, and the prosecutions which followed were all won by default. Already a vast improvement in the labeling of medicines has resulted. The long familiar claims, "a sure cure," "a reliable remedy," etc., are being replaced on the labels by much more modest statements, such as "will be found beneficial in" or "will relieve many of the symptoms of." Fewer nostrums than formerly are alleged to be cures for such serious diseases as tuberculosis and cancer. The second amendment, known as the net-weight act, which dates from March 3rd, 1913, requires that all packages shipped in interstate commerce shall be plainly and conspicuously marked to show the quantity of the contents. Although effective from the above date, this law provides that no penalties shall be imposed for 18 months, and the Bureau confesses that it may be years before all the necessary data have been collected to insure equitable enforcement. Elaborate studies are now being made of such problems as shrinkage, variation of containers, errors in weighing, measuring, and counting by hand or machinery; i. e., the factors that may defeat the best intentions of the manufacturer to comply with the provisions of the law. For the study of shrinkage, experimental shipments of a great variety of goods are being made to detect changes in weight and bulk due to variations in temperatures and humidity, and the normal water content of foods is being investigated.

The Central Electric Companies' Problem

THE central electric companies have lately awakened to face a serious problem, the successful solution of which is essential to their future welfare.

The typical central electric company, a public service corporation, has but few electric generating stations. These, however, are large and economically located, usually on a river bank, so that water and coal costs, which are large factors in generating cost, may be reduced to a minimum. The prime movers are of the most efficient, and therefore most expensive type. Automatic devices, conveyors, etc., reduce the operating force to a degree that is surprising to the uninitiated.

At first glance one who had not investigated the proposition, would say instantly that a small private plant could not compete with a central plant such as is outlined above. If relative generating costs were the only consideration the private plant would at once be tabooed. The real features to be considered, however, are "What will it cost to generate the required power in a private plant?" and "At what rate could this power be purchased from the central electric company?"

The cost of generation, or power plant operating expense, represents less than twenty per cent of the expenses of the central company. The other expenses include taxes on property and lines, electrical losses on the company's lines (about one third the power sold because of leakage, etc.), interest and depreciation on equipment, advertising expenses, selling charges, uncollectable bills, and interest on bonds and stocks. The private plant expenses include only interest and depreciation on equipment, and cost of operating plant.

The above statements explain primarily why the private plant of a large building can compete with the central power company, but there is a secondary reason which is quite as important. A large amount of steam is required in large office buildings, apartment houses, hotels, etc., for various purposes. The heating system requires steam for approximately half the year, and the laundry, the cooking and refrigerating systems of the restaurant, and the hot water service require steam throughout the year.

Strange as it may seem, a private power plant supplying electricity and exhaust steam for the above purposes requires but little more coal than would be required for boilers supplying only the steam required for the building, no electricity being generated. This fact is due to the large amount of energy in the exhaust steam, the engine utilizing only about five per cent. The highly efficient engines of the central power company utilize about 17.5 per cent of the energy in the steam, or in other words, the private plant requires three and a half times as much coal to generate electric power as the central company. Add to this the greater coal, water, and attendance charges for a small plant and the two propositions appear to be on a par if only the electricity is considered.

If, however, electricity is purchased from the central electric company, boilers must still be operated to supply the necessary steam for the building. Much of this steam could be obtained from the engine exhaust of a private plant, and that is why the private plant of a fair-sized building is a paying proposition.

Allowing for the cost of operating boilers to supply the steam for the building, the cost of electricity for the year with a private plant of fair size would be only 40 to 70 per cent of the cost of electricity purchased from a central electric company.

That the actual condition of affairs is known to building managements is shown by the following statistics published in technical journals of recent years:

Buildings—Per Cent Having Private Plants.

Office buildings of twenty-six cities	63
New York buildings over eight stories high and occupying area over five thousand square feet	70
New York hotels, two hundred rooms or over, more than ninety in number	95

Many large buildings would install a private plant, but owing to the layout of the building, etc., a private plant never having been considered when they were constructed, they are limited to a heating plant.

The central electric company's field is limited to the buildings just mentioned and the small consumers. The problem of the central electric company is to increase its field of operation, or expressed in other words, to reduce the price of power to the consumer and yet obtain a good profit.

Two propositions are being considered by central electric companies to bring this about. The first is to use the exhaust steam of the engines of their plants for the manufacture of ice. Objections may be made to this on the ground that in winter, when the demand for ice is a minimum, the load, and therefore the amount of exhaust steam to be utilized, is a maximum. In summer these conditions would be reversed. Granting, however, that the ice plant would pay the operating expenses of the electric generating plant, the price of power to the consumer would not be radically lowered, for, as already stated, the cost of generation is less than 20 per cent of the expenses of a central company.

The second proposition considered is to establish a number of small power plants in buildings in the business section of the city and sell both electricity and heat to the surrounding buildings. A plant of this nature could not be operated more economically than a private plant, and would have the additional expense of its share of the advertising, selling, loss by uncollectable bills, and interest on the bonds and stocks of the company. The capital necessary to carry out this scheme would be enormous, as it would mean the complete revision of the electrical system, and as is indicated above, its efficacy would be very doubtful.

Evidently neither of the above plans is a successful solution for the problem, and even though the central electric companies should go into the ice business, the private power plant would still be a good investment for a building of reasonable size.

Economy in the Philippine Weather Bureau

THE ways of the powers that be in dealing with scientific institutions often give rise to extraordinary situations. The latest illustration of this fact comes to us from Manila, where on December 18th the veteran director of the Philippine Weather Bureau, Father José Algué, appeared before the Philippine Commission and, after pleading for two hours, succeeded in persuading that enlightened body not to impose upon the staff of his bureau a choice between starvation and the abandonment of their work. A poignant climax was reached when the director, who, with all his scientific skill and learning, is the embodiment of simplicity and sincerity, offered to relinquish the whole of his own salary, if his faithful subordinates might thereby be saved from a reduction of pay; an offer that is recorded to have produced "heart throbs" among his official auditors. The scene is thus described in a Manila newspaper:

"It was a picture not soon to be forgotten by those who were present at the afternoon session of the Commission yesterday. It was the picture of a man who has devoted his life to a great work, who has sacrificed much that he might benefit not only the Philippine Islands, but the whole world by the results of his researches. It was the picture of Father Algué pleading with the law-makers that the work which has meant so much might continue and that, at his own sacrifice if need be, some trifling recognition of faithful services be accorded to his subordinate co-workers."

As everybody knows, the policy of the new administration in the Philippines is to reduce the expenses of government; in other words, official salaries. It is not yet clear just how the present upheaval is going to affect the large and able body of scientific workers who have been attracted from America and other countries to take service under the Philippine government, and accordingly we refrain for the present from discussing this phase of the subject. The employees of the Philippine Weather Bureau, however, are in a class by themselves. They may be regarded as permanent inhabitants of the Philippines and are not influenced by mercenary considerations in the choice of their field of labor. The director and a few of his chief assistants are Jesuit priests; the rank and file are natives.

The institution which ultimately became the Manila Observatory was founded by the Jesuits in 1865, and from the beginning has devoted itself especially to the task of protecting the islands from typhoons. Numerous outlying stations have been established from which reports are telegraphed daily to the observatory, where they are charted with reports from stations in Japan and on the China coast. Far to the eastward telegraphic outposts have been established in the islands of Guam and Yap. With its broad outlook, the mature experience of its officials, and facilities for rapidly issuing warnings by wire and wireless, not only to all parts of the archipelago, but also to vessels upon the high seas, the observatory is recognized throughout the Far East as an absolutely indispensable means of safeguarding life and property from the dreaded typhoons, of which, in an average year, about twenty-five actually enter the Philippines, to say nothing of many others which sweep across the adjacent seas. Incidentally, this meteorological service has compiled the climatic statistics necessary for placing scientific agriculture in the Philippines on a sound basis; has made a systematic study of earthquakes, volcanoes, and terrestrial magnetism in the islands, and maintains work in practical astronomy.

After the American conquest the observatory and its network of stations were taken over by the new government, without any changes of personnel or organization, and were known thereafter as the Philippine Weather Bureau. The service is not in any way connected with the Weather Bureau of the United States.

The cost of maintaining this service, which was acquired without any initial expense, has been modest to the verge of absurdity. Especially in the matter of salaries has the history of the Philippine Weather Bureau been such as to delight the most parsimonious dispenser of public funds. In spite of a trifling increase in 1911, the average salary paid to each of the eighty-three employees who constitute the meteorological division of the service, counting in the relatively magnificent stipend of $2,500 drawn by the director, is approximately $335 a year. Some of these men have served for twenty-five years. All have proved faithful in the performance of arduous duties requiring more or less technical skill. Last but not least, if they should suspend their labors the unpreparedness of the islands for the first storm that came along might conceivably cost more in devastated property, not to mention the loss of life, than the entire expense of operating the bureau from its foundation to the present time.

Yet Father Algué only persuaded a thrifty legislature not to *reduce* the salary fund of his bureau!

Science

A Memorial to African Explorers.—On November 21st Lady Scott, widow of the Antarctic explorer, unveiled a tablet in the parish church of Cranbrook, England, to the memory of Lieut. Boyd Alexander and Capt. Claud Alexander, who lost their lives while exploring in Africa three years ago.

Spread of Gypsy Moth by the Wind.—Experiments conducted by the U. S. Bureau of Entomology prove that the newly-hatched caterpillars of the gypsy moth may be blown, under favorable conditions, a distance of six miles or more. Thus the wind is an important factor in the spread of this destructive pest.

Elliott Cresson Medal for Molecular Air-Pump.—The Franklin Institute of the State of Pennsylvania has awarded its Elliott Cresson Gold Medal to Prof. Dr. Wolfgang Gaede for his molecular air-pump, in consideration of the very great value of this invention for the quick production of vacua beyond those hitherto obtainable. A description of this pump appears on another page.

The "Fram," the most famous polar exploring ship in the world, will not, after all, have the honor of being the first vessel to pass through the Panama Canal. After waiting at Colon since October 3rd, she has now started south on the long journey to the Pacific *via* the Straits of Magellan. It was feared that an indefinite delay at Colon might prevent her from reaching San Francisco by the time Capt. Amundsen plans to start for the Arctic regions next Summer, in which case the expedition would have to be postponed for a year.

Pellagra and Stable Flies.—It is now generally supposed that pellagra is carried by some biting insect, and the buffalo gnat, among others, has been suspected. Investigations recently carried on in Spartanburg County, S. C., by the U. S. Bureau of Entomology and the Thompson-McFadden Commission of the New York Post-graduate Medical School, practically exclude the possibility of transmission by the buffalo gnat, but tend strongly to show the possibility of transmission by the stable fly, already known to be the carrier of several other diseases.

The Canals of Mars.—Prof. Lowell telegraphs to us from Flagstaff, as follows: "The canals of Mars are now exhibiting a very striking seasonal development from north to south over the planet surface, being darkest and strongest near the edge of the melting north polar snow cap and thence gradually pushing farther and farther southward. This is exactly in accordance with what the Lowell Observatory has predicted for their behavior from its extensive and critical study of the planet, and is corroborative of Lowell's theory. This observed development of the canals is somewhat similar to the annual inundation of the Nile."

The International Catalogue of Scientific Literature, published annually, in seventeen volumes, each devoted to a particular science, has recently completed its tenth year of publication and is regarded as an indispensable part of the working equipment of scientific libraries throughout the world. Although the volumes are issued by the Royal Society of London, the undertaking is truly international, representing the co-operation of 32 governments or national institutions. The committee of the Royal Society which has the oversight of this work is also engaged in completing the great Royal Society Catalogue of Scientific Papers, which covers the scientific literature of the nineteenth century and of which subject-indexes are in course of publication. All scientific workers will be dismayed to learn that there is grave danger of the suspension of this splendid bibliographic undertaking on account of lack of funds. An international subscription ought to be started at once to prevent such a calamity.

Improvements in Meteorological Instruments formed an important part of the work of the Weather Bureau during the last fiscal year, according to the annual report of the Bureau recently published. Investigations of anemometers were carried on with a view to the standardization of these instruments for measuring high wind velocities. A large motor-driven whirling machine having a horizontal arm 30 feet long and capable of being driven at all velocities up to 75 or 100 miles an hour, measured at the end of the arm where the anemometer is installed, was used for these tests at Mount Weather Observatory. Valuable data have been secured, but the investigations have been temporarily interrupted by the appointment of the official who was conducting them to the position of Chief of the Weather Bureau. Important progress has also been made in the revision of psychrometric tables. The most interesting instrument devised during the year was an automatically recording rain-gage, which can be left without supervision for a period of eight days and will make an accurate record of the rainfall during that period. An instrument of this character has been urgently needed for installation in places where it is impracticable to station a resident observer.

Automobile

Seats Heater in the Steering Wheel.—A steering wheel having in its face a recess is provided with a closure for the recess and an electrical heating unit is carried by the closure within the recess, the same being shown in a patent No. 1,082,830 to Rubin S. Smith of Marshall, Texas.

Air-brake for Motor Trucks.—An air-brake, so called, has been added by the manufacturers of a French motor truck as part of the regular equipment. The device is not what is generally understood as an air-brake in this country. It is more of a dynamometric fan, or fan-brake, similar to the mechanism employed in striking clocks. When the motor truck is on a long down grade on which continued application of hand or emergency brakes would burn the brake lining, the driver pulls the "air-brake" lever. The revolving shaft acts by means of a bevel gear upon a wide-bladed large fan mounted horizontally below the body of the truck. The resistance of the atmosphere to the forward motion of the fan blades retards the shaft revolutions sufficiently to brake the truck. Objection to the device has been raised because of the great tendency to whirl dust upward against the truck.

A New Binary Automobile Motor.—Something entirely new in the application of the binary vapor principle to automobile engines has been brought out by an English inventor. Condensed into its vital facts the new device is a four-cylinder motor in which the cylinder nearest to the radiator has been supplanted by a steam cylinder. The cooling water of the gasoline motor, when heated by the cylinders, is led into a compressor and subsequently forced into the steam cylinder where it is charged under pressure with the hot exhaust gases from the three gasoline cylinders. The pressure of the now superheated steam-gas mixture forces down the piston in the steam cylinder, which piston is connected to the crankshaft by the usual connecting rod. In effect the new motor is an engine with three cylinders of the internal combustion type, and a fourth cylinder in which the heat of the exhaust gases is utilized as pressure. The inventor claims a fuel reduction of about 20 per cent and a steadier running of the engine.

Power Consumption of Electrical Apparatus.—Since the general introduction of electric lighting and engine starting equipment on the modern automobile, the question of its power consumption has been a moot one. Manifestly, the figure must vary with varying equipment, and with different cars, but much light has been shed on the question by a number of tests recently made on the Long Island motor parkway. The tests were made with a six-cylinder five-passenger touring car weighing 4,862 pounds "all on" and driven with top up, windshield in place and side curtains on. The illuminating equipment consisted of ten lamps which were kept burning. The test was conducted by the Automobile Club of America. Four runs were made, two at 20 miles an hour with the generator in action and out of action, respectively, and two at 40 miles an hour under the same conditions. Briefly, the results revealed that whereas 7.3 gallons of fuel would drive the car 100 miles at 20 miles an hour with the generator not running, 7.6 gallons would be required with the generator in operation; at 40 miles an hour the gasoline consumption per 100 miles, without the generator running, was 8.7 gallons, and with the generator in operation, 9 gallons. The difference in fuel cost per 100 miles, at the average rate, is approximately six cents.

France Offers Prizes for Kerosene Engines.—By way of stimulating the use of kerosene as a motor vehicle fuel, for which the French automobile industry is convinced there is a great future, the Automobile Club of France, located in the French capital, is to hold a series of tests of kerosene engines commencing October 1st next, with prizes to aggregate $12,400; the first prize is $10,000, the second $2,000, and the third $400. The test is not a carbureter test, but is designed to demonstrate the usefulness, fuel consumption, etc., of four-cylinder engines rating between 20 and 30 horse-power, of the automobile type. Each engine entered, for which the fee will be $30 prior to April 1st and $60 after that date and up to July 1st, must not weigh more than 33 pounds per horse-power exclusive of fuel and water tanks. Engines can be started on gasoline, provided this fuel is not contained in a tank that forms part of the equipment. There will be four bench tests—three hours each at full and half load, two hours half full speed and two hours light—during which the fuel consumption must not exceed (for qualification) 350 grammes per horse-power hour. Subsequently, the engines will be placed in chassis the minimum weight of which is to be 14,040 pounds, for road trials which will cover four days, in which the vehicles will be driven 620 miles at an average speed of 19 miles an hour. Throughout the tests, paraffin having a density of 810–820 and a flash test (Granier instrument) of 35 degrees, will be supplied to contestants. Points from 0 to 20 will be awarded for performance, fuel economy and general operation, etc.

Astronomy

The Light of the Earth.—It has been remarked that the globular light from the whole sky is superior to the sum of all the quantities of light sent to us separately by the stars. Even the most sombre regions seem lit by a diffused light which truly has its origin in the terrestrial atmosphere. It is the light of the earth. Different people have endeavored to evaluate the intensity of this earth light and have found that it is of the order of one tenth part of the intensity of a star of the first order of magnitude. It is attributed, at least partially, to a permanent aurora borealis which is revealed by the characteristic green ray which is observed on obscure nights in the whole heavens. There is probably something else: the continual bombardment of the upper atmosphere by meteoric swarms and cosmic dust may also illuminate. The mass of meteoric matter which would suffice to explain the observed phenomena has been calculated and the figure found is in good agreement with that given by a direct calculation of the quantity of cosmic matter which strikes the earth.

Stars of Class B.—Stars of which the spectra are particularly marked by the lines of helium and hydrogen are designated as class B in the Harvard classification. **The general opinion is that these stars are very hot,** that they are of great mass, with a high pressure in the atmosphere that surrounds them. They are also regarded as very young in the order of their evolution; being preceded in this respect only by the stars of class *O*, which comprises relatively few stars. As the result of detailed researches by P. W. Merrill, it appears that the distribution in the heavens of stars with brilliant lines accords with that of all the stars of class *B*; they are even relatively more numerous among the stars of class *B* superior to the fifth order of magnitude, which seems to indicate that there is a greater chance of encountering stars with brilliant lines among the very big stars. There are also cases, the most remarkable being that of the Pleiades, where a certain number of these stars seem very closely grouped, and it is difficult to admit that these groupings are fortuitous.

The Constitution of Comets.—Great diversity of opinion has prevailed on the subject of the physical constitution of comets. It has been maintained, by different astronomers, that the nucleus of a comet is solid, is liquid and is gaseous. If we agree with Schiaparelli and see a relation between comets and the swarms of meteorites, it is difficult to avoid the conclusion that a comet is a cloud of solid particles, and we return to the theories of Prof. Newton, who regarded comets as veritable "sand-banks." What are the dimensions of these constituent particles? We do not know; we can only say that in all probability they vary in size from a grain of dust to a body of several cubic yards. However this may be, the particles are certainly separated from one another by great distances, and, speaking on a small scale, we may liken a comet to a number of particles about the size of a pin's head at distances of some hundreds of yards. Each particle carries with it a gaseous envelope formed principally of a substance furnishing a spectrum analogous to that of the hydrocarbons. Under the action of the sun, and perhaps through some electrical effect, the envelope becomes luminous or phosphorescent. This view of a comet's structure explains the fact that even the feeblest stars may be seen through the cometary cloud, without suffering either appreciable diminution in brightness or refraction.

The Age of the Earth.—Certain colored minerals, in particular certain micas, when examined microscopically, present dark stains in the form of a disk. At the center of each stain is a little crystal, usually a crystal of zircon which has been included at the moment of formation of the mica. The explanation of these dark stains is to be found in the fact that the zircons are strongly radio-active. The radio-active crystals stain the mica in the same way as they color glass, etc. But the x-rays emitted by different radio-active substances have not all the same penetrating power, and for that reason the mica stains are usually darkest at the center. If they are old enough the stain is uniformly dark, as even the few rays which reach the outer part have had time to completely stain it. Experiments were made by Joly and Rutherford to determine experimentally the number of x-rays required to produce a given stain in mica. Measurements were made on the halos or stains so produced and they were compared with those produced naturally by the zircon crystals. The amount of uranium present in the crystal was evaluated and the number of x-rays necessary to produce the natural stain permitted one to ascertain the amount of uranium which must have disintegrated since the origin of the mineral. The theory of radio-active transformations then leads very simply to an expression for the age of the halo. The numbers obtained oscillated between 470 million and 20 million years, which is in fair agreement with the determinations of the age of rocks, although they differ from the results which have been deduced from the quantity of salt contained in the oceans.

A New Way of Throwing Messages from Aeroplanes

By Lucien Fournier

AS the flying machine developed, the need of subsidiary apparatus became apparent. Military men soon demanded the installation of wireless apparatus, guns, armor and similar accessories. While a great deal of experimenting has been done to give them what they want, it can hardly be said that a very great measure of success has as yet been attained. Especially is this true of the wireless equipment. The sending apparatus which can be carried on an aeroplane is necessarily of very small range, and the receiving apparatus must struggle with the difficulty of interference. Some day these objections will undoubtedly be overcome, but until they are, a French inventor and aviator, Paul Fugairon, believes that some such apparatus as he has invented and tested near Brest will be more acceptable to military men. With his invention a message can be dropped in full flight by an aviator who is sufficiently near his destination, the craft returning immediately at full speed to the enemy's position. There is no danger that the message will be blown away by the wind, or that it will be lost or damaged in mud, dust, high grass, and heavy foliage.

As the accompanying diagram shows, the apparatus consists of a hollow cylinder, in which the message is received. At its base the cylinder is inclosed by an ogival member *P* into which lead has been poured, so that the apparatus will always drop upon the point *P*, which passes freely through the lead. At the other end of the cylinder is a cover *L*, the top of which is formed like a lantern with four open windows *C*. Within the cover are four clamps to hold material for a Bengal fire. This is ignited by the explosion of a cap of mercury fulminate. As the apparatus strikes the ground, the cap is exploded by the firing pin *B*, which is guided in two brackets, and the flame of the explosion being conducted to the Bengal-fire material through the curved tube *U*. A lever mechanism here connects the firing pin *B* with the point *P*, the lever mechanism being held in a position of rest by the spring *R*. As soon as the point *P* penetrates the ground the spring *R* is compressed, the lever mechanism is operated to pull the pin *B* backward a short distance, and to release it immediately afterward. The firing spring which was put under tension before the message was dropped, is thus liberated, so that the pin *B* is forced against the fulminate cap.

The exceedingly bright Bengal fire which flashes up can be seen not only at night, but in daytime as well. What is more, it burns long enough to allow a soldier who has been watching for it to cover a distance of 300 yards to the spot where it has fallen, and whither its light guides him.

Obviously not only written messages, but also sketches and rough maps can be "canned" in this way.

By means of this simple device messages can be discharged from an aeroplane with the certainty that they will be found. As soon as the device strikes the ground Bengal fire is ignited, and the resultant smoke indicates where the message is to be looked for.

Traveling Crane for Building Construction

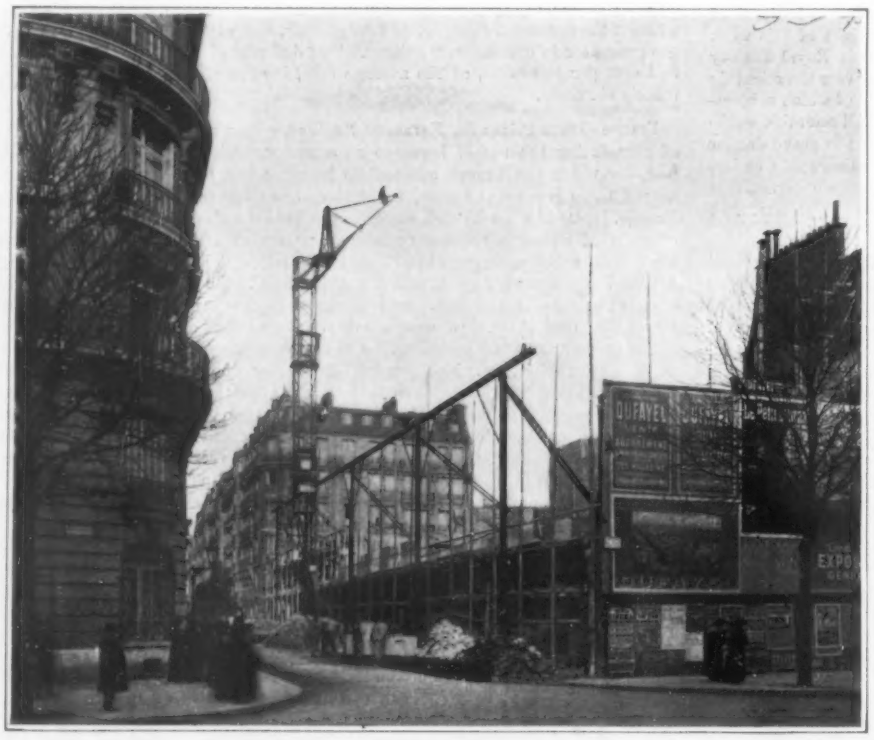
A NOVEL type of crane has been devised in France for handling materials in building construction. It consists of a lattice-steel mast mounted on four wheels, two of which run on a track placed on the ground parallel to the front of the building, and the other two on a track about forty feet above the ground. The latter is maintained in position by uprights and tie-rods secured in the mass of the building foundation. The construction is clearly shown in the engraving which represents one of these cranes in service on the Boulevard Malesherbes, Paris. The track is supported at frequent intervals, and is furnished with holes about four inches apart to provide for attaching it at places appropriate to the requirements of the building.

The mast is constructed of angle iron spaced about four feet apart and stiffened with cross braces. The head of the mast carries a turntable set out from the center about four and one half feet so as to carry the load well into the interior of the building. The crane proper can make a complete revolution, thus avoiding accidents which occasionally occur in cranes that cannot make a complete turn, because in a violent windstorm the boom can set itself in the direction of the wind, like an ordinary weathervane, without coming in contact with any fixed portion of the structure.

The boom is arranged in such a way that the lifting block may be positioned in accordance with the weight of the mass to be lifted. For a weight of 1,500 kilogrammes (3,300 pounds) a reach of seven meters (23 feet) can be used, while the crane can lift 7,000 kilogrammes (15,000 pounds) at a distance of one meter (3.3 feet).

The mechanism of the crane includes in addition to the lifting gear means for propelling itself along the track and also means for swinging the boom. There are two lifting speeds operated by friction clutches. The transporting movement is accomplished by cone gearing and friction clutches. In order that the load may be properly served by the crane it is essential that the operator should be able to see the work which he is doing. For this reason the operator's cabin can be placed upon the mast at any required height, variable with the state of advancement of the work. The great advantage of this type is that it does not encumber the road. Half a meter (1.64 feet) is sufficient to secure the passage of the apparatus between the scaffolding on the one hand and the regulation scaffold on the other. The height of the apparatus is variable. It has been used up to a height of 35 meters (115 feet), while the reach has been carried to 12 meters (39 feet). A special arrangement allows the use of the apparatus on an inclined path. In one case two cranes of this type were used in the construction of a viaduct on a 32 per cent slope.

In the case of a building on a corner, it is useful to be able to serve the two frontages by means of a single transporter mast crane. For this purpose a turntable has been designed, allowing the crane to pass from one frontage to the other in a few minutes.



Traveling crane as used in erecting a Paris building.

Citropsis

THIS name is given by W. T. Swingle and Miss M. Kellerman to a new genus of tropical African fruits, which may be called generically in English "African cherry oranges." The species, of which there are several, were formerly assigned to the genus *Limonia*, under which they figured as the sub-genus *Citropsis* in Engler's classification. The authors above named find, however, that they are much more nearly related to *Citrus* than to *Limonia*, and this relationship opens up interesting possibilities for the plant-breeder. In their natural state some species of *Citropsis* bear an abundance of delicious fruit. Greenhouse experiments at Washington show that at least one of the species can be grafted readily on several *Citrus* stocks, while *Citropsis* serves as a successful stock for grafting grapefruit and oranges. Any new stock available for grafting citrus fruits is a lucky find, since it generally increases the range of soils adapted for the culture of such fruits and adds to the chances of combatting disease.

Whale Meat is becoming a more and more popular article of food in Japan, where it is not only sold fresh, but also canned on an extensive scale. Canned whale meat is used by the Japanese army as a field ration. The chief objection to its more general use appears to be its strongly fishy taste and odor.

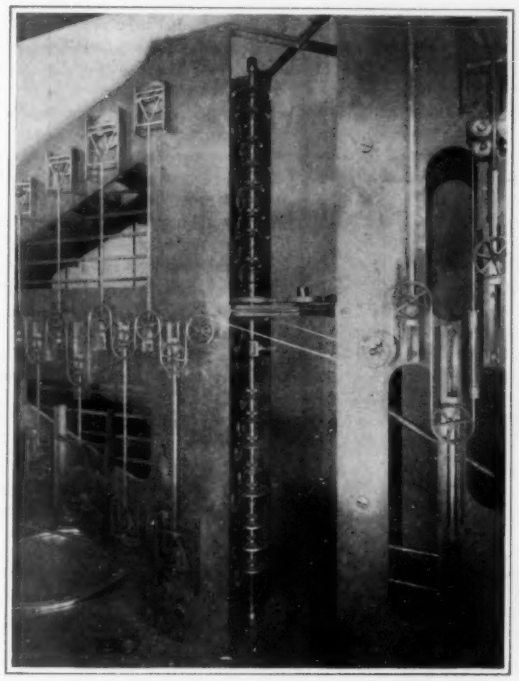
A Great Brass Brain

A Unique Engine, on the Accuracy of Which Depend Millions of Dollars and Thousands of Lives

By C. H. Claudy

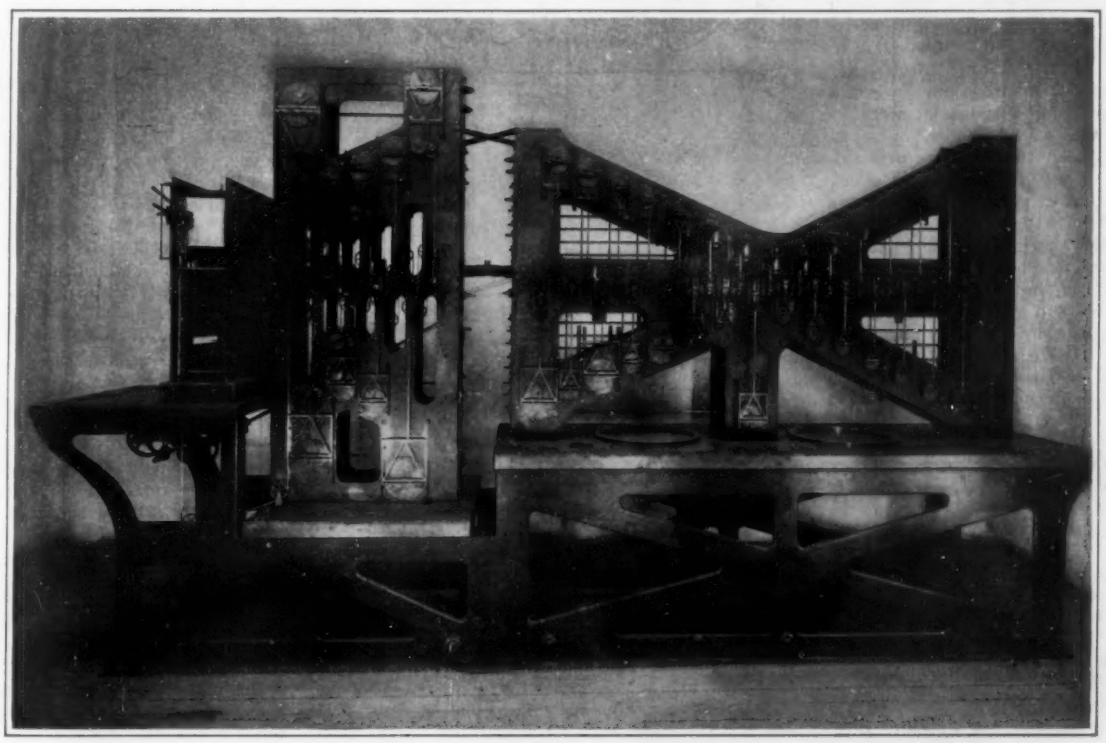
ROGER BACON, man of letters and of science, who lived in the thirteenth century, is supposed to have manufactured a brazen head or android, which spoke and revealed "dreaded secrets of the past and future." But no brass brain has come down to the present day from antiquity which can even think, let alone articulate through a brass mouth.

But a mechanism, built for these United States of ours, can truly be called a "brass brain," in that it does the mathematical calculations which would otherwise require a hundred flesh and blood brains to do; and if it does not actually articulate its results, at least it indicates them plainly enough, not only by dials, but by writing them down. Still more does it claim kinship with that ancient and fabled brass brain of Bacon's, in that it, too, foretells the future, though no "dread secret" does it make known.



Where tidal component differences are gathered together.

Front view, showing controls, dials and tidal curve plot.



Side view of the tide recording machine, showing the pulleys and chain that govern the movement of the pen.

This introduction may seem fanciful—it is sober fact. The machine is known as the United States Tide Predicting Machine, Number 2. It is in daily operation in the United States Coast and Geodetic Survey at Washington. Its work is nothing less than the predicting of the times and heights of high and low tide, a year in advance. Its mechanism is of brass and steel, its house a huge mahogany and glass case, and its tender one observer, who does but sit and turn a crank until it stops, then copies off on paper the reading of several dials, and later removes from the machine a roll of paper on which is plotted the tidal curve for the particular spot along the coast, the tides of which have been predicted.

Every year the United States issues a fat book of Tide Tables, primarily for the use of its navy, and secondly for the use of all who go down to the sea in ships. This book of Tide Tables gives the time to the minute and the height to the nearest tenth of a foot of every high and low tide during the year for seventy of the great world seaports, and by means of an auxiliary table, the same information for 3,000 other places.

It is essential for the mariner to know when tide is high and when low, and the magnitude of the tide. The safety of his ship and the lives of all on the vessel may depend on that information being accurate and reliable. So that when it is a question of predicting for some day in the future, just when high water will be reached in New York harbor, or when low tide will occur in the Golden Gate, and just how high or how low the tide may be, you can be very sure that the machine which prophesies is an accurate if complicated machine. That it is a wonderful machine may be imagined. It has over 15,000 parts, but so carefully is it made that lost motion is reduced practically to zero. Unlike the human brain, this one of brass cannot make a mistake. How wonderful this is, it is difficult to conceive without some knowledge as to how a tide is actually produced and how it would be predicted by the use of pencil and paper alone—the oldest way known, and also the longest and least accurate.

As most people know, the tides are the names we give to those periodical risings and fallings of the ocean which occur daily. They are produced by the action of the force of gravitation between the sun and moon and earth. The tides are thus the result of forces which come under observation of the astronomer, and it is astronomical data which is used in predicting a tide.

If the earth was a perfect sphere, covered all over with water to a uniform depth; if the earth went around the sun in a circular path with the sun in the center and the moon went around the earth with a perfectly uniform motion and if sun, moon and earth were always in the same plane, tide prediction would be a simple matter of mathematics; the heights of a tide for all ports in any one latitude could be made together.

But the earth is *not* a perfect sphere, it *isn't* covered with water to a uniform depth, it has many continents and islands and sea passages of peculiar shapes and depths, the earth does *not* travel about the sun in a circular path, and earth, sun and moon are *not* always in line. The result is that two tides are rarely the same for the same place twice running, and that tides differ from each other enormously in both times and in amplitude.

For many years tide predictions were made entirely by manual and mental labor, and because of the complication of the matter, but few of all the causes which enter into a tide were considered in actually predicting how high a tide would be, and when it would be in flood.

But Sir William Thompson, now Lord Kelvin, revolutionized matters when he devised what he termed a system of "harmonic analysis." It is evident that if a pencil be made to rise and fall as the tide rises and falls, on a vertical sheet of paper which moves under the pencil, a curve will result. It is also evident that if a sufficient number of observations are made to get rid of those tides which are late or early because of wind, or high or low because of freshets on land, the remaining tide curves, if averaged, will bear a definite relation to the actual tidal causes. Sir William Thompson found that he could analyze these tidal curves.

He began by imagining a fictitious sun, which moved evenly in a circular path about the equator at a uniform speed. The real sun doesn't move that way at all. But the theoretical sun, being a figment of the imagination, did as it was told. To this obedient sun was

added another sun which moved differently, and still another moving still differently, and so on, until a very respectable number of imaginary suns were circling about the earth. These suns were all so calculated that the sum total of their attractions and movements equaled the sum total of the attractions and movements of the real, sure enough sun! Instead of having one sun in an irregular number of positions and distances, Lord Kelvin imagined a number of perfectly regular suns, which did what they were told as to unvarying motion, but which, when combined, equaled our own irregular sun.

The same thing was done for the moon; and behold a whole lot of definite, regular, undeviating mathematical factors, all together equaling the puzzling irregularities of our real sun and moon, but separately so well behaved that they could be used all the time as components of a mathematical equation which would demonstrate a tide.

All the most important of these theoretical suns and moons, or components of the tides, as they are called, were computed by Sir William Thompson and extended and improved by Sir George Darwin, brother of the great Darwin. Since that time, these components of the tide have been computed for practically all the important tide stations in the world and are common property.

It didn't take Sir William Thompson long to figure out that if harmonic analysis could predict tides from data gathered from an observed tidal curve, then the components which could be extracted from a given position of sun, moon and earth ought to be able to be put into a tidal curve. From this was but a short step to actually making the first tide machine, which took account of but ten components of a tide, but actually plotted a predicting tide curve.

This first tide predicting machine was followed at intervals by four others, two for England, one for France and one for Brazil. But conceiving a tide machine is one thing, making one practical, another, and all the various machines failed to take account of any great number of tidal components. Then came Prof. William Ferral of our own Coast Survey, who, in 1881, designed a tide predictor which was used by the Coast Survey for twenty-seven years. It was the first tide predicting engine to show on dials on its face the time of day, time of year, height of tide, etc. Instead of producing a tidal curve, it required only that an observer copy off the data to have it ready for the printer. All the other machines had traced curves from which a calculator had to work, digging out, literally by its roots, the data in numbers, from the curve in front of him.

The underlying principle of all these tide predicting machines has been the same—the summing up mechanically of a number of different motions, actions and reactions. The means is a slender chain, passing over pulleys, each of which is mounted on a shaft or crank. The crank is adjustable, so that it can be made more or less eccentric with the shaft itself. The degree of eccentricity represents the amplitude of the particular component (or imaginary sun or moon) of the tide under consideration. When the machine is operated, the various cranks revolve, and the chain which passes over them all is pulled upon by some and allowed to become slack by others. The movement of the end of the chain, then, becomes the sum of all the movements of all the components in the machine, each represented by a crank, adjustable on a dial.

By attaching the end of the chain suitably to a pen, and by having a moving sheet of paper beneath the pen, the machine traces the tidal curve. The principle of this mechanical summation is illustrated in the diagrammatic sketch, in which five component slides are shown. Reference to the photographs will show how these are operated; an adjustable steel crank-pin on each disk or wheel works in a horizontal slide in a light steel frame, an extension member of which terminates in a pulley, *C*, *D*, *E*, *F*, and *G*. Passing over and under these pulleys is the steel chain of the apparatus, one end of which is fixed (*A* in the diagram) and the other end of which is suitably connected with a movable pen *B*, which plays against a ribbon of paper that passes beneath it.

If we suppose the disks 1, 2, 3 and 4 in the diagram are fastened and stationary, and imagine a counterpoise weight connected to the chain beyond the pen *B*, then it is obvious that if the disk 5 revolves and at the same time the ribbon of paper passes from right to left under the pen, a true harmonic curve will be produced as in the line *ZZ* (of course the curve will be a solid line in practice; dotted lines are here used for clarity).

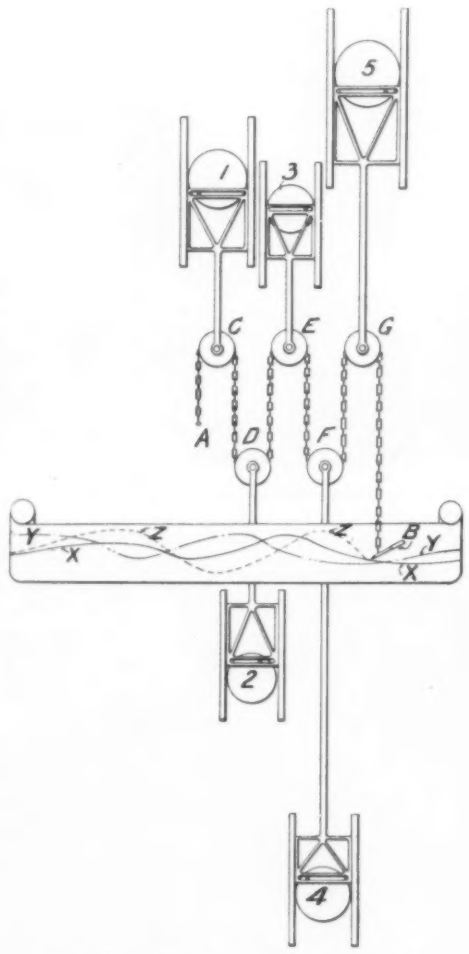
If now we suppose the disks 1, 2, 3, and 5 to be fixed and immovable, and disk 4 to revolve, another type of curve will be produced on the moving sheet of paper, as in the curve *YY*.

Now if disks 1, 2, and 3 be kept fixed and immovable, but disks 4 and 5 are permitted to revolve, then the curve traced upon the paper will be the sum of the two curves *ZZ* and *YY*, as shown in *XX*. If all five of the disks revolve, then the resulting curve will be the sum of all their curves individually.

If each disk in its speed of revolution represent the effect of motion of a lunar or solar component of a tide, and each crank on each disk is set so that its distance from the center represents the amplitude of such motion, then each disk, crank and slide truly represents a factor of a tide—the effect of one of the fictitious moons or suns, the sum total of the motion of which expresses the tide itself.

The Ferral machine was wonderful and accurate for a while. But it wore badly with years of use, its slender shafts were not sufficiently rigid to keep an error of torsion out of the results, and it was decided after twelve years that a new machine, better and quicker, more accurate, and more reliable, should be made.

Mr. E. G. Fischer worked upon the Ferral machine. Later he became Chief of the Instrument Division of the Survey. When it was decided to build a new machine, it was to Mr. Fischer that the authorities turned. He designed a new machine, and after the plans were accepted, went to work. Only such time as could be spared from the regular work of the Instrument Division was put into the new machine, which was fifteen years in building. But now it is finished, and stands forth as the most remarkable, most accurate and most complete machine of its kind in the world. It takes account of thirty-seven factors or components of a tide. It is truly American in its design, for not only does it do what all the foreign machines have done, plot a tidal curve by pen and ink, but it does also what the Ferral machine did—presents the results on dials for visual reading. It not only gives the times of high and low tide, but shows by a time line on the tidal curve sheet the hours, so that the state of the tide at *any* time can be readily computed.



How the curves are summed up mechanically.

The machine is entirely automatic, once it is set. The observer sits at the end, and turns a crank. When it will turn no farther the hands point to the day, the month, the hour, the minute, and the height in tenths of a foot of the tide. Pressure of a button in the crank releases it, and the next stop indicates the same data for the next tide. All the time the machine is doing this it is also tracing out the tidal curves, which are filed away for reference, so that should any question arise as to the figures as the operator takes them down, the machine need not be reset to get them over again; reference to the tidal curve will show all that the machine has shown.

The machine is two sided; one side has the tidal fluctuations to care for, the other, the time, so that when the prediction is made, it is complete. The copy, as it is made from the machine by the observer, goes directly to the printer, ready to be set up and printed.

Mr. Fischer strove long for some scheme by which a mechanical means of summation could be obtained which would eliminate a chain. Always he came back to it as the most practical. Every single thing about this wonderful machine was made by the Instrument Division (castings for the base are excepted) save the chain, which is fine chronometer chain, imported from England. To be sure that it was properly stretched, and worn and smooth in its actions, Mr. Fischer ran it in an endless belt form, over dozens of pulleys of all sizes, on the walls of his workshop, driving it eight hours a day by electric motor for months and months. It was bent in every link, not hundreds, but thousands of times, until, when it was put in the completed machine, it had done all the wearing possible.

As an instance of the extreme accuracy of the machine, Mr. Fischer told the writer of some tests which were made of it.

"We picked out two stations for these tests," said Mr. Fischer, "which we believed would most thoroughly test the machine because of the complicated nature of their tides. These stations were Aden, Arabia, and Hong Kong, China. For Aden we used thirty-five components of a tide and for Hong Kong thirty-three.

"We started the predictions at the beginning of a year and ran the machine until it had predicted the tides for almost the whole year at both these places. Not until then did we take a reading. Then we read the prediction for a given day. When we compared this reading, which had come after the machine had had a chance to add up infinitesimal errors through a year's predictions, with that of the most careful and accurate human calculation, we found a maximum error of 0.02 of a foot for the Aden tide, and 0.06 of a foot for the Hong Kong tide."

To do the same work in the same time, taking in the same number of factors or components, would require one hundred men. One wonders whether they would be anywhere near so accurate as the great brass brain.

The machine bears upon its face, by order of the Superintendent of the Coast and Geodetic Survey, the legend "Designed and constructed by E. G. Fischer." It is a monument not only to those men who went before—Lord Kelvin and Prof. William Ferral—but to the gentleman whose profound knowledge of mathematics, skillful ability in instrument work, and cleverness as a designer, made possible the greatest and most remarkable calculating engine in the world.

The Quantum Theory of Energy

THE old controversy so beloved of the Greeks as to whether matter is continuous or discontinuous is in our day definitely resolved in favor of the latter view. It is true that the ultimate particles of matter are considered to be something in the nature of local modifications of the ether, but nevertheless, matter as matter has a discrete structure. This tendency to atomize has now been imported into the conception of energy. At first sight it would seem that energy is something necessarily continuous, but it is found that this assumption leads us into serious difficulties. It is by examining the phenomena of heat and light radiation from bodies that scientific men have been led to adopt the remarkable hypothesis which postulates an atomic structure for energy.

When, by a process of strict reasoning from certain fundamental and well-established principles we arrive at an expression for the amount of radiant energy emanating from a hot body and existing in a unit volume of the ether, we have two very astonishing results. In the first place, experiment shows that the total amount of energy existing in a unit volume of the ether is distributed among the rays of different wave lengths in such a way as to be a maximum for a certain wave length (depending on the temperature) while our theoretically obtained expression does not admit of a maximum. In the second place, according to our formula the total quantity of energy would be infinite, a result which cannot be admitted. Planck, the great German physicist, was accordingly led to consider a radiating body as made up of a number of small bodies called resonators, the energy of which varies in a discontinuous manner. The total energy possessed by any resonator (which might be an atom of sodium, for example) at any time must be a whole multiple of some fundamental unit of energy. The atom of energy in any case depends upon the frequency of oscillation of the resonator and is, indeed, simply proportional to it. This very strange theory enables a formula to be obtained for the quantity of energy per unit volume of the ether due to radiation which agrees with experiment, possesses a maximum, and gives a finite value for the total quantity of energy. It was discussed before a distinguished audience at the last meeting of the British Association and promises to be of great importance in many branches of scientific investigation.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

A Plan for Safeguarding Miners

To the Editor of the SCIENTIFIC AMERICAN:

Concerning the number of lives yearly exacted in coal mining from explosions, black-damp, roof falls, flooding of passageways in mines, and for which no adequate means has yet been devised to counteract by allowing miners an opportunity to escape, the problem leads me to submit for your consideration a plan by which in nearly all cases of mine disaster the loss of life could be averted. The plan, as any practical man can see, would entail on mining companies a large additional expense, but for humanity's sake mining companies have been compelled by legislation to adopt equipment for the safeguarding and welfare of mine workers.

The idea is as follows:

By referring to Fig. 1, the wall of one side of the main passage should be undercut or sloped as shown in sketch to receive a pipe or tube twenty-four inches in diameter by one quarter of an inch thick, riveted and calked watertight. This emergency tube to extend throughout the main passages of the mine, this tube to have watertight doors placed every hundred feet apart, and where there is a vertical shaft, grab irons or steps be riveted on inside of vertical portion of tube to top of mine shaft.

The operation or use of such a tube would be as follows:

In the event of a "cave-in," or the roof collapsing, cutting miners off from the outside world, and bringing them face to face with death from starvation or thirst, the miners would enter pipe or tube through manhole nearest to them and get through or past the "cave-in" or fall, and return to daylight, home and life without having heart-rending accounts published of men buried alive. In fact, operations could be carried on the same as usual while the "cave-in" was being removed.

In the event of a mine explosion, provided there was no fire vomiting from mouth of mine, the miner could escape the danger from "black-damp," or the deadly gas which follows a mine explosion. Of course, these manholes and doors should be closed from the inside as soon as the last man has entered. The fan blast system in use in mines could be arranged so as to feed the emergency tube constantly with fresh air. This emergency tube could extend to top of both the down and up shafts, allowing escape from a mine either way.

In the event of a mine getting flooded with this means of escape at hand no lives would be lost, for men with nerve enough to work in a mine, would possess sufficient nerve to take advantage of this means of escape to save their own lives by entering the tube which would lead them to the world above, their families and complete safety.

I hope for humanity's sake this idea will be made use of. I do not know of any channel more suited to exploit this suggestion than the columns of the SCIENTIFIC AMERICAN, which reaches men engaged in the great work of making our industries safer and more attractive to the worker.

The initial cost of such an emergency tube should not be any more prohibitive than the cost of hoisting engines, pumps, fans, or any other kind of equipment necessary for the mining of coal. I feel assured that such an appliance would decrease by a large percentage the number of lives annually lost and chronicled as imprisoned, overcome by black-damp, or drowned by not having a means of escape.

Detroit, Mich. GEORGE W. BOWIE.

An emergency tube for miners.

Philippine Industries

To the Editor of the SCIENTIFIC AMERICAN:

Our attention has been invited to certain articles appearing in the SCIENTIFIC AMERICAN from time to time concerning the industrial situation in the Philippine Islands. Particular reference is made to an article appearing recently in which the extension of hat making in the Philippine Islands was discussed. We believe it well to bring to your attention some first hand information on what is being done along industrial lines in the Philippine Islands, and to refer you to certain publications of the Bureau of Education on industrial subjects.

The Bureau of Education maintains a very complete system of industrial instruction in the Philippine public schools. Special attention has for some time been given to basketry, loom weaving, lace making and embroidery, wood working, iron working, and domestic science and sanitation. The industrial system has gradually been extended until at present 93 per cent of the pupils in the Philippine public schools receive some form of industrial training. Most of those not receiving industrial instruction are in the secondary grades.

The Bureau of Education has published for nearly two years an industrial magazine under the title, *The Philippine Craftsman*. This magazine was founded for the purpose of encouraging industrial instruction and making available to all interested parties the results of the industrial work in different sections of the islands and the plans for further extension of industrial instruction into the public schools. It encourages the development of native arts and the introduction of such as will prove of economic value to the people.

Manila, P. I. C. H. MAYER, *Acting Director*.

That Coin Problem

To the Editor of the SCIENTIFIC AMERICAN:

The following is my answer to the United States coin problem, published in the SCIENTIFIC AMERICAN of February 7th:

100	1-cent	$1.00
9	5-cent	.45
13	10-cent	1.30
13	25-cent	3.25
13	50-cent	6.50
13	2.50 gold	32.50
13	5.00 gold	65.00
13	10.00 gold	130.00
13	20.00 gold	260.00
200 coins.		$500.00

THEODORE L. DELAND, *Shipping Clerk*.

United States Mint, Philadelphia, Pa.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of February 7th, on page 117, under the heading "A Problem in United States Coins," the question is asked, "How can 200 coins of the United States (present coinage) be so divided as to total $500? Every coin to be used at least once." Here is one answer:

60	.01	$0.60
6	.05	.30
6	.10	.60
6	.25	1.50
14	.50	7.00
68	2.50	170.00
28	5.00	140.00
6	10.00	60.00
6	20.00	120.00
200		$500.00

Possibly there are other combinations, or perhaps the question is not complete. F. M. GREENE.

Minneapolis, Minn.

[We can publish no more letters on this subject.—EDITOR.]

A Miniature Volcano

To the Editor of the SCIENTIFIC AMERICAN:

Recently I saw a very interesting imitation of a volcano, and as it may be of interest to your readers, I shall describe it.

A slag pot, containing about four tons of slag from a lead blast furnace, had been set on the dump to settle before being tapped. The top was covered with a crust of slag which would take a good blow with a sledge to break. In one place near the center was a hole where the slag was still red hot and molten. Every little while flames came up from this and some gas was given off, throwing the slag up around the edges till a mound was formed around the hole. Every minute or so a flame and some smoke shot up and some slag overflowed the top and ran down the sides till it cooled, thus building the mound higher. These eruptions continued about one or two minutes apart till the mound was about six inches high. Every one consisted of flame, smoke, a flow of lava, and then a period of quiet. This continued till the pot was tapped, perhaps twenty minutes, when the withdrawal of the slag stopped the eruptions.

A mixture of adobe and water had been put in the pot before the slag had been tapped into it, to allow the shell to come out easily, and probably a reaction between this and the hot slag caused the phenomena.

The tapper at the dump informed me that he had seen a number of these little volcanoes, but they were by no means common. EDWARD P. CHAPMAN.

Pueblo, Colo.

The First to Signal Through Space

To the Editor of the SCIENTIFIC AMERICAN:

In a notice of John Walker Wilkins, in SCIENTIFIC AMERICAN of January 31st, it is stated that he was "the first man in the world to transmit telegraphic signals through space." From data in the notice, it was not earlier than 1845 or 1846 that he did this, three or four years subsequent to the time that Joseph Henry, American physicist, had "traced the influence of induction to surprising distances, magnetizing needles in the lower story of a house through several intervening floors by means of electrical discharges in the upper story, and also by the secondary current in a wire 220 feet distant from the wire of the primary current." (Enc. Brit., 9th ed., vol. xi, page 675.) In connection with these experiments he discovered the oscillatory nature of the electric discharge. I know of no earlier signaling through space by the use of electric currents.

Carlisle, Pa. I. THORNTON OSMOND.

The "Nevada" and "Queen Elizabeth" Compared

To the Editor of the SCIENTIFIC AMERICAN:

I noticed in one of your recent publications remarks by Mr. C. P. Slosson, San Francisco: the comparison of the British "Queen Elizabeth" and United States "Nevada;" also remarks on speed of British battle-cruisers. I also noticed your answers to said remarks. Now if you will permit me, I would like to say a few words.

In the first place, I may say it has always been a very great pleasure to me to read your valued paper. A Britisher naturally likes fair play, and I am sure the SCIENTIFIC AMERICAN puts a thing fairly and squarely before the public. Of course, in making a comparison it is only fair to compare contemporary ships. Now, take into consideration the four great events or essentials in a warship, viz., speed, radius of action, gun power, and defensive armor. Of course, the British ship has the advantage, a great advantage, in speed. In radius of action, as both ships are to use oil fuel exclusively, and as reliable data are not at hand, I cannot say for sure as to which has the advantage on that point. In gun power we have ten 14-inch guns with 1,400-pound shell, and 2,600 foot-seconds; energy, 65,606 foot-tons on the "Nevada." Eight 15-inch guns with 1,950-pound shell, 2,500 foot-seconds; energy, 84,510 foot-tons on the "Queen Elizabeth." Here we see the British ship, although carrying fewer guns, throws a heavier weight of metal at a discharge with a greater energy, which would be more effective at long range. The weight of the American gun is 63.1 tons. The weight of the British gun is 96 tons; both 45 calibers long. In defensive armor or qualities of defense the principal interest in the "Nevada" class is their great defensive power and the armor has been, or will be, so disposed to a greater advantage than on any ship hitherto built, at least from the American standpoint. From a British standpoint the armor is so disposed on the "Queen Elizabeth" to the greatest possible advantage; the armor on both is about the same maximum thickness, so in recapitulation we have "Queen Elizabeth," greater speed; "Queen Elizabeth," greater gun power; "Queen Elizabeth," at least equal defensive power; "Queen Elizabeth," questionable radius of action. You cannot put a quart of power in a pint of displacement, and as both displacements are about the same, for the displacement given of British ships are their displacements when in commission with full load of stores, ammunition, etc., but with normal coal capacity, I take it that British designers have turned out the better ship, more especially as the cost per ton is less in the case of British ships. Take for instance contemporary ships "Neptune" and "Delaware." The British "Neptune" works out $418 per ton. The United States "Delaware" works out about $450 per ton. The British ship "Lion" worked out at $382 per ton. W. R. SHUTE.

Woodstock, Ontario.

Roadside Signs, each containing a single catchy sentence in large type, are proving effective in warning against fires on western forests. They give the essentials and tell the importance of protection against forest fires.

Gaging station at Gatun spillway. Measuring the flow (18,000 cubic feet per second) from a suspended car.

First water discharging through the Gatun spillway after the lake has been filled to the full 85-foot level.

Navigating Lights for the Panama Canal

How Ships Will be Guided Through the Canal by Night

THE lighting equipment of the Panama Canal has been planned with the same care and skill that has been displayed in the other parts of this monumental work. Through Gatun Lake and at the approaches the sides of the channel will be marked by gas buoys, and except in Culebra Cut, a set of flashing range lights will be placed at each end of the successive tangents. The sailing lines, as indicated by the range lights, will be sufficiently wide apart to enable the largest vessels to pass one another in safety.

In Culebra Cut, the banks are so close together as to make the use of range lights impracticable. In this part of the canal, three lighted beacons will be placed at each angle or turning point in the cut and between these there will be intermediate lights in pairs on each side of the canal. While these lights are deemed ample for safe navigation, it will not enable travelers to see very much of that famous locality should their ship pass through on a dark night. All the beacon and range light towers along the canal will be of molded concrete.

The locks, however, will be brilliantly illuminated by electricity. On the walls of the locks there are molded concrete lamp standards, carrying hoods of concrete in which are mounted large, 400-watt, tungsten bulbs. The hoods will be so arranged as to throw the light on the coping of the lock, and the water chamber, but will screen the lights from the axis of the canal. If these brilliant lights were not shaded, the pilots on approaching vessels would be so blinded as to hinder them from observing the range and signal lights. Excepting the locks, acetylene will be used exclusively for lighting the canal both in the towers and on the buoys. These lights will be automatic in the sense that they will require absolutely no attention for a period of from four to seven months after they have been once started. At the end of that time their supply of acetylene is replenished and they are good for another period. This system, known as the A. G. A. (American Gas Accumulator Company) system, was first introduced in this country in 1908, and since then has been installed in over three hundred important light stations on our coast.

This system has perhaps its highest development in the gas buoy. The lighted buoy is considered one of the most important and reliable aids to navigation invented in recent years. The lights of those installed by the lighthouse authorities on various stations on the coast, are plainly visible from six to fifteen miles and will burn for long periods up to a year or more without any attention. The buoys along the canal will be equipped with sixth order lights, and the gas supply in each beacon is designed to last from three to seven months, the time depending upon the characteristic of the light. These buoys will be of the same standard type used generally by the lighthouse service. Its structure is indicated in Fig. 1, and it consists of a cylindrical floating steel body carrying on its top a pyramidal steel frame which supports a light and lens fifteen feet above the water level. To the bottom of the body is attached a steel tube carrying a counterweight, and this tube is made detachable from the buoy body to facilitate transportation. The buoy will be moored on its station by heavy chain and concrete sinkers. The corrosive effect of the waters of Gatun Lake, due to decaying vegetable matter, is very pronounced, and hence the metal surfaces will be given a special protective coating.

The body is eight feet in diameter and has dished heads, and in the periphery of the upper one are four pockets for the reception of the cylinders containing acetylene, technically known as "accumulators." The gas from the four accumulators passes out through a collecting manifold and thence up a feed pipe secured to one of the upright frame pieces to the lantern.

The acetylene in the accumulators is stored according to the process invented jointly by three Frenchmen, Claude, Hess and Fouche. This gas, at ordinary atmospheric temperature, is very unstable under a pressure of more than two atmospheres, as it readily breaks down into carbon and free hydrogen under slight shocks, and this is usually accompanied by a violent explosion. When stored by the process mentioned, it is practically safe and harmless. The cylinders are first filled with an inert porous mass having a porosity of eighty per cent, and half the porous space is then filled with acetone a hydrocarbon liquid which boils at 56 deg. Cent. The acetylene is then forced into the cylinders under heavy pressure. The acetone readily absorbs acetylene at atmospheric pressure and under a pressure of 150 pounds it will absorb over one hundred times its volume. The liquid acetone expands in absorbing acetylene and shrinks again to its original volume when the gas is exhausted. The purpose of the porous filler is to prevent the accumulation of compressed gas in the upper part of the accumulator when it is nearing exhaustion. A full description of this method of storing acetylene will be found in the SCIENTIFIC AMERICAN for May 6th, 1911, page 453. A gas plant will be established at Balboa, where the accumulators will be recharged when exhausted, and the acetone which may be carried out with the acetylene will be replaced.

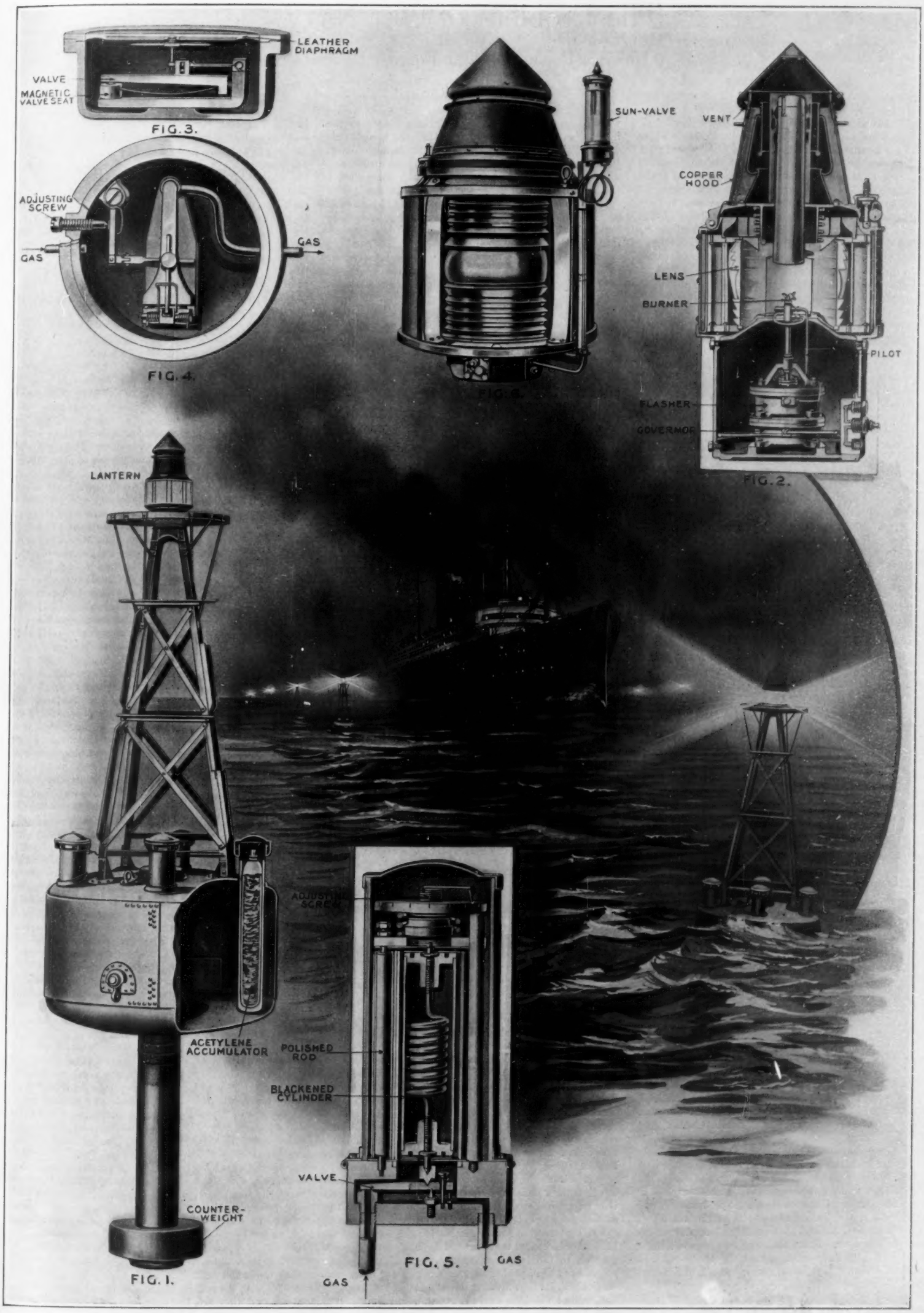
All the canal buoys will have flashing lights possessing several interesting and novel features. The mechanism, as will be seen from Fig. 2, consists of three parts: the pressure reducer or governor, the flasher and the burner. The high-pressure gas from the accumulators goes first to the governor which operates to feed the gas at a constand low-pressure to the flasher. Two sections of the simplest form of flasher are shown in Figs. 3 and 4. It is the invention of Gustaf Dalen, a Swedish engineer. This consists of a heavy cup-shaped casing closed at the top by a leather diaphragm. In the side wall is a gas inlet for the low-pressure gas from the governor and a gas outlet leading to the burner. The inlet is always open, but the outlet to the burner is controlled by a pivoted valve which opens at stated periods, to permit gas to escape to the burner to produce the flash. In order that the valve may move at high speed, the valve seat around the outlet is made one pole of a permanent magnet, and the valve plate is acted upon by a spring to hold it in closed position. The valve plate is connected by an adjustable loose motion device with the diaphragm. When the valve is closed, gas accumulates in the casing under the diaphragm until its pressure is sufficient to overcome the force of the spring and the magnetic attraction of the valve seat. Then the valve opens with a jump and the gas escapes to the burner where it is ignited by a constant burning pilot flame fed directly from the governor. The escape of gas permits the diaphragm to fall and the valve closes quickly. By this mechanism, the pressure of the gas at the burner is constant throughout the duration of the flash, which is a very important feature, as it enables a pilot to judge accurately the characteristics of the light. It is also economical, as it has been found that 55,000 separate and distinct flashes can be obtained from one cubic foot of acetylene. They may be adjusted to give light periods as small as one tenth of a second, but on the canal the minimum period will be three tenths of a second. To give the various lights individual characteristics, a more complex form of this flasher will be used which will produce successive flashes, followed by dark intervals. Although this apparatus is very delicate and capable of fine adjustment, still the parts are so well protected that the buoys can withstand the buffeting of the heaviest seas without derangement.

By an ingenious arrangement of glass prisms on the inside of the vertical bars of the lantern, the light will be so reflected as to prevent the bars from casting any shadow. This is important; for in the older types much of the light is obstructed by the bars and lost. Acetylene light, which is almost pure white like sunlight, has a great penetrating power in thick weather, and as it burns with a small and intensely bright flame, it is easily adjusted in the focus of the lens which facilitates a uniform spread of the light in all directions in a horizontal plane. The hood shown is of sheet copper and serves for ventilation and is so constructed as to make it impossible for wind or sea to extinguish the light.

This type of buoy has been placed on such im-

(Concluded on page 214.)

Typical morning fog rising out of Culebra cut. Such fogs will make navigation difficult.



The luminous buoys that will be used to guide vessels through the Panama Canal.

The Problem of Our Navy

II.—Sea Power and Our Foreign Policies

By the Editor

WE have it on the authority of the greatest of all books of wisdom that "No man liveth to himself"; and what is true of the individual may be applied with ten-fold emphasis to the nation. Although ambition is one of the most compelling forces in the make-up of the average individual, there has always been a minority of men who would gladly forego the larger prizes if they might only pursue their plan of action well out on the edge of the maelstrom of life, and as far removed as possible from the hazards of its central vortex. Hence, the hermit of early times and the shy recluse of our own day.

History can afford instances, not a few, of states and nations which have exhibited, from the very day of their birth, a decided spirit of reserve, a wish, sincere, well reasoned out, and formulated as a definite principle of action, to work out their destiny in an attitude of international aloofness, even if it involved isolation.

To find a conspicuous example of this spirit it is not necessary to go beyond our own borders. When our fathers "brought forth a new nation, conceived in liberty and dedicated to the proposition that all men are free and equal," they warned this country against any "entangling alliances" with foreign powers. The young Republic, guarded and guided by a Constitution into which its noblest men had written its highest ideals, set itself to the task of realizing those ideals in the unhindered development of the country, vast in extent and rich in its natural resources, of which, by the sword, it had recently won acknowledged possession.

Set midway between the Occident and the Orient, separated by a barrier of three thousand miles of ocean from the one, and by five thousand miles of the little-known Pacific from the other, the new-born State believed that its problems lay, and would forever lie, strictly within its own borders, and that its national policies would always be purely domestic in character—that they would never broaden out into policies of an international scope.

And so, for a full century of its existence, the United States worked out its destiny along and within the lines laid down by its founders. In numbers, wealth, industry and commerce it grew amazingly, and if war came, it was a war of defense. The one definite policy that was pregnant with possibilities of European complications, the Monroe Doctrine, was adopted early in our history at the suggestion of Great Britain, whose fleet stood ready in those early years to enforce the doctrine should it be challenged. It is only in late years that the Monroe Doctrine has loomed up in all its portentous significance.

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Josephus Daniels, Secretary of the Navy.

Whether or not we shall have a first-class navy to enforce our policies depends in part on him.

Hence, throughout the first century of our national existence, the armed forces of the country, both naval and military, were regarded and designed purely for purposes of defense; and it is significant of this spirit and of the purely national as distinguished from the international character of our policies, that our first three battleships, the "Oregon," "Massachusetts" and "Indiana" were officially designated as coast-defense battleships—they were not designed, nor were they qualified, for service in far-distant waters.

Then, in the midst of our self-engrossed and aloof national life, came the roar of the "Maine" explosion; and before our President could exhaust the last resources of diplomacy, the United States was at the death-grip with a European nation! The century-long day of our isolation was over. From that war we emerged a great world power, to find ourselves standing toe-to-toe with the naval and military giants, young and old, of Asia and Europe.

How many of the eighty millions of us, in 1898, realized that in reaching out a pacifying hand across the few miles of water dividing Key West from Cuba, we were commencing to move our frontiers out into the international ocean highways of the world, and that when, at the close of the war, the extension had ceased, those frontiers would have been pushed nigh a thousand miles eastward into the Atlantic, and westward some five thousand miles, even to the very doors of Asia.

Not for a moment did the nation regard the Spanish war as one of aggression; it was supposed to have been fought in the interests of humanity, and for the abatement of the horrors of the Cuban situation. If we remember rightly, the diplomatic intercourse, antecedent to the war, deplored the disturbing conditions *"on"* or *"near our borders."* It was the propinquity of the trouble that brought it within our concern—had Cuba been off the coast of Spain, the rebellion might have been raging yet, so far as any protest from this country would have been concerned. But, in fact, though not with definite intent, this nation, in declaring war against Spain, abandoned a policy of isolation for one of commanding importance in the great-world politics!

It is for us, now, either to play the games with great-world weapons and on a great-world scale, or confess ourselves unequal to the task, let go what destiny thrust upon us and be subjected by the leading powers to that attitude of interested tolerance which obtained before the war took place. There is no middle course. In the Atlantic the struggle left us in possession of Porto Rico, with oversight of Cuba and the possession of Guantanamo Bay, one of the finest strategical bases in the West Indies. In the Pacific we emerged with full responsibility for the Philippine Islands and holding also Guam, a most valuable strategic base in the Mid-Pacific. Verily, we have given hostages to fortune.

It is extremely significant that the subsequent course of our foreign policies, so far from showing any disposition on the part of the Administration to deplore the conditions which had established us in a very strong strategic position in both the Atlantic and Pacific Oceans, has rather indicated that we were disposed to utilize that position to the fullest advantage. Stimulated by the successes of the Spanish war, we built up our navy, and particularly its first fighting line of battleships, so assiduously that within a single decade we had risen to the second place in naval strength. With a natural naval base at Guantanamo, giving us a commanding position in the Caribbean, we took in hand the seemingly impossible task of cutting a canal from the Atlantic to the Pacific at Panama. For certain concessions we acquired the treaty rights of Great Britain at Panama, proclaimed the neutrality of the canal, and prepared to maintain that neutrality by erecting first-class fortifications at each approach. Not content with this, we proceeded to reaffirm the Monroe Doctrine by definite Congressional action, forbidding the acquisition by alien powers of harbors or coaling stations which were located within striking distance of the Panama Canal and which might serve as a base for hostile operations.

It is well understood that commercial rivalry is becoming more and more the predisposing cause of modern wars. Our opening of the Panama Canal will cause an upheaval in existing trade conditions and a quickening of commercial rivalries the like of which the world has never seen. Furthermore, its effect upon the balance of naval power, particularly in the Pacific, and in any conflict which may arise over the enforcement of the Monroe Doctrine, will be most profound. What Gibraltar and the Mediterranean were to the contending navies of the eighteenth century, the Panama Canal and the Caribbean will be in the future naval wars of the New World.

And across this key to the commercial supremacy and the naval dominance of the Western Atlantic and the Pacific the United States stands, a colossus dominant and uncompromising.

If we were slow in taking up our position as a world power, history will never charge that the United States was slow to assert the prerogatives of a world power. Not content with our reaffirmation of the Monroe Doctrine, which doctrine a recent friendly British critic has described as "the most magnificent bluff in all history; and, so far, the most successful," we have taken the vast problem of China into our benevolent keeping and have spoken out boldly for the "Open Door of Trade" as against Europe's pet theory of separate spheres of influence, thereby setting our face firmly against any attempt to destroy the integrity of that greatly coveted country. Lastly, we have looked squarely in the eye the most intelligent, refined, proud and successful of the Oriental races, and told it that we do not want and will not have its members in our midst. And this we have done to a people who, by defeating on land and sea the supposedly most powerful nation in the world, had but recently graduated, by universal consent, to the rank of a first-class naval and military power.

Such are the international policies of the United States in this year of our Lord 1914.

Discoursing on the subject of the policies of nations, a recent naval authority has this to say: "Modern science has made the nations of the earth neighbors, and modern thought has tempered the intercourse of many races, but national ambitions take life and grow as the nations prosper and, being like those of the individual, essentially selfish, the ambitions of one nation often excite the rivalry and opposition of another. So are born the policies of various peoples. When declared, these policies are but the formulated principles of conduct which the people of a State, or their Government, have adopted in the pursuit of their national well being. *When the policies of a State reach beyond its borders, they become of special interest to other States, for, as has been intimated, in these policies may be found the seeds of disagreement, perhaps of ultimate war.*"

Of such a character are our international policies. They are broad enough to bring us into most intimate contact with the policies of the other great powers of the world, and they are, therefore, big with possibilities of acute disagreement and ultimate war.

When a nation thus formulates its policies, it should

definitely determine both the manner of their presentation to the rival nations whose interests may be affected and its own subsequent attitude in case these policies should be attacked. It may offer them as a request, to be granted or refused or ignored as the case may be, or it may boldly proclaim them as being so necessary to the national well-being and honor that they will be supported, if occasion should require, by all the armed forces of the State.

Now it is evident that to present such ambitious international policies as have been adopted by the United States in the form of a request would be as futile as it would be ridiculous—their very magnitude and daring is taken by the world at large as an intimation that we are prepared to defend them with all the available forces at our command.

And this brings us face to face with the question:

Do we possess, or are we likely to possess in the near future, sufficient power to resist such armed opposition, and by crushing opposition, enforce the consideration of our policies upon any future enemy or coalition of enemies? To this the answer must be made that, because of the geographical situation, a war for the maintenance of our policies must of necessity be a naval war, and that the navy of the United States is utterly inadequate to the magnitude of the task. The struggle for the enforcement of the Monroe Doctrine, the neutrality of the Panama Canal, Asiatic Exclusion, or the Integrity of China, will take place upon the high seas, and the situation is such that in the event of war to-day or to-morrow, we would find ourselves in the precarious position of having to defend first-class policies with a third-class navy.

We do not hesitate to say that the work of bringing the American navy up to the Standard of Strength called for by our national policies is by far the most pressing question now before the American people, its Congress, and its President.

It may be said of the people of the United States, as a whole, and to a great extent, of Congress itself, that they are so deeply engrossed with internal economic questions that they follow with a languid interest the course of international politics. It is only to a few in our Foreign Affairs Committees and in our diplomatic and naval and military services, that the portentous significance of the events which have led us to the present conditions have been known, and by them only has the alternative of either a disgraceful abandonment of our policies or a humiliating defeat in their attempted defense by inadequate naval and military forces been foreseen.

Universal arbitration, to which we all look forward with eager eyes, would present a way of escape from the existing dilemma, but the comparatively meager results of such Hague meetings as have been held, due to keen international distrust, has shown that this remedy is as yet in the far future.

And since arbitration is for the present at least but a beautiful dream, it behooves this nation to take careful count of things as they are and make at once a drastic readjustment between our policies and our sea power. We must modify our policies by retrenchment, or we must at once take all needful steps to bring the navy up to the full measure of its heavy responsibilities.

The nation is confronted with two alternatives, and two only. Either we must give up Guantanamo, Porto Rico, Hawaii, Guam and the Philippines; leave China to the rapacity of the Great Powers; dismantle our forts at Panama, placing the canal under joint international control, rename our first fighting line "coast-line battleships," and withdraw entirely within our own frontiers, or we must accept the burdens of a great world power, not with hesitation, but rather with a glad courage, remembering that these burdens are not of our own seeking, but have been laid upon us by a destiny against which there is no appeal!

The Scientific American and the Libraries

WE gather from a recent issue of the Boston *Transcript* that the SCIENTIFIC AMERICAN has been critically compared with every important periodical published in this country, with the result that it stands in a very special class of magazines favored by Massachusetts librarians. A committee was appointed at the fall meeting of the Massachusetts Library Club, which unanimously reported the following resolution:

> The members of the Massachusetts Library Club view with strong disapproval the alarming decadence in tone of many of the leading American periodicals, and emphatically protest against the tendency recently so manifest to cater to sordid sensationalism, indecent suggestion and to perverted taste.
>
> The committee has had several meetings, at which have been discussed the merits and demerits of certain leading periodicals, and it has prepared a list of fifty magazines which are recommended for small libraries, arranged in groups of ten, to cover the demands of libraries subscribing to ten, twenty, thirty, forty or fifty periodicals. This list it is proposed to print in the next issue of the Massachusetts Library Club Bulletin, and the committee also suggests that the State Library Commission publish it for distribution among the smaller libraries of the State. It is not to be understood that all of the reputable journals are included. The list is limited by the number chosen, and by the plan by which the committee endeavors to put in each group of ten magazines which should appeal to the various classes of a community. A list has also been made of twenty magazines, covering special subjects of a more or less technical nature. One or more of this special list could be inserted in the place of one in each group of ten, according to the demands of each locality.

In the first group, which comprises those periodicals which are indispensable to every library, however small, we find mentioned in company with the SCIENTIFIC AMERICAN, the following magazines: *Atlantic Monthly*, *Harper's Magazine*, *National Geographic Magazine*, *Outing*, *Outlook*, *Popular Mechanics*, *St. Nicholas*, the *Survey*, and the *Woman's Home Companion*. In group IV, which comprises magazines that are recommended to libraries which are able to pay for at least forty periodicals, the SCIENTIFIC AMERICAN SUPPLEMENT is recommended in addition to the *American City*, the *American Magazine*, *Bulletin of the Pan-American Union Republics*, the *Craftsman*, the *Dial*, the *Etude*, the *Illustrated London News*, *Popular Science Monthly* and *System*.

In Group III, which comprises magazines intended to cover the demands of libraries subscribing for thirty periodicals, we find mentioned in addition to *American Homes and Gardens*, which is published by Messrs. Munn & Co., Inc., publishers of the SCIENTIFIC AMERICAN, the *Boston Cooking School Magazine*, *Current Opinion*, the *International Studio*, *Modern Priscilla*, the *North American Review*, the *Review of Reviews*, *School Arts Magazine*, *Scribner's Magazine*, and the *Technical World*.

This analysis of current American periodicals is interesting and important because it shows how the Massachusetts Library Clubs Committee rates magazines in closely allied fields. *Popular Mechanics* and the SCIENTIFIC AMERICAN are evidently not regarded as covering the same field, for both are included in the indispensable magazines which even the library capable of subscribing for only ten periodicals should keep on hand.

All the publications of Munn & Co. find a place in one of the groups. The publications of the Century Company (the *Century Magazine* and the *St. Nicholas Magazine*), and Messrs. Harper Brothers, who publish *Harper's Magazine* and the *North American Review*, are the only other publishers of periodicals similarly honored.

Despite the flood of home and garden magazines which have made their appearance within the last ten years, only one other periodical of that type besides the *American Homes and Gardens* is mentioned in the groups, and that is the *Garden Magazine* of Messrs. Doubleday, Page & Co., which is included in Group II. *Country Life in America* is placed in a special list of twenty magazines "covering special subjects of a more or less technical nature."

Commenting upon the analysis the Boston *Transcript* states:

> "The report, and the accompanying lists, have allowed some librarians, inferentially and diplomatically, to ease their minds on the subject of some of the putrescent fiction which appears in a few magazines. This is a good thing.
>
> "It would be hard to estimate the exact amount of moral harm worked by this near-indecency in periodicals. Probably it is very small. The worst thing about it is the sickening insincerity of it all, and its result upon literary freedom. After a few years in which a diluted form of sewage is offered under the name of 'red blood,' and slightly smutty stories are sold under the plea that art, truth, and frankness are in peril unless such stories are allowed, then there is apt to be a reaction in favor of prudishness. The news agent who whispers to you that he has got 'something shady' which he would like you to buy, may not be an admirable person, but he is worthy of rather more respect than the magazine editor who offers the same thing with a hypocritical plea that this is 'artistic truth.'"

Skating on Salt

By Walther Isendahl

NATURE has been conquered once more. Men can skate, not on ice, but on salt. A salt-skating rink, constructed by the patented process of Dr. Ed. Arnold, was recently exhibited and operated in Berlin.

All skaters will welcome the invention of a method of producing, by purely chemical means and without the employment of a costly refrigerating process, a saline crystalline mass which exhibits all the characteristic properties of ice. The surface of the mass can scarcely be distinguished from a surface of natural or artificial ice, and the resemblance is increased by the fact that the shavings produced by the skates have all the appearance of snow. The mass is entirely odorless and contains no ingredient injurious to the health or the clothing of the skaters. It can be utilized for skating, with ordinary ice-skates, in every season and climate, except when the temperature is higher than 86 deg. Fahr.

The mass can be applied to any tight floor of wood, cement or asphalt, from which it can easily be removed by chipping or steaming. It is preferable to construct the skating floor in a building, but it may be installed in the open air, if it is protected from rain, drying winds, summer heat and direct sunshine by a shed, tent or other covering.

Boards can be coated with the mass and can be quickly assembled to form floors of any desired size, which can be taken apart as quickly. In this way temporary skating floors can readily be introduced on the stage and in public or private festivals, indoors or in the open air. Slides for coasting can be constructed by a similar method.

The costs of construction and maintenance of a salt-skating rink are moderate. The construction is very simple. The mass is melted and poured on the floor, where it quickly solidifies and forms a hard, smooth surface. It is applied in successive layers, each less than 1/25 inch thick. The cost of upkeep is small, for the "wear" is less than that of ice, especially at low temperatures, and the abraded "snow" is collected, melted with fresh material and used again. The mass taken from old skating boards or rinks can be utilized in the same manner. The quantity required for a single layer is less than 1/5 pound per square foot. A fresh layer must be applied from time to time, with a frequency proportional to the use of the rink. Two applications per week usually suffice. A surface of 5,000 square feet can be kept in condition by three hours' daily work of one attendant, in addition to occasional sweeping.

During an exhibition which was recently held in the exhibition building of the Berlin "Zoo" a demountable skating surface composed of wooden planks was used very largely and its durability was thoroughly demonstrated.

The Passing of the Sturgeon

IN his last annual report the United States Commissioner of Fisheries says that "the story of the sturgeons is one of the most distressing in the whole history of the American fisheries." For years these large, inoffensive fishes were supposed to be of no value, and when, as often happened, they became entangled in fishermen's nets, they were knocked in the head and thrown back into the water. When it was discovered that the sturgeon's eggs were valuable as caviar and its flesh as food a period of reckless fishing began, and in a few years the best and most productive waters were depleted, and what should have been made a permanent fishery of great profit was destroyed. On the Atlantic coast the catch of sturgeon fell from 7,000,000 pounds to less than 1,000,000 in fifteen years, and an even more rapid decline occurred on the Pacific coast and the Great Lakes. At present the total annual yield for the whole country is less than 1,000,000 pounds, and is decreasing. Meanwhile the demand for the eggs and flesh has steadily increased, with the natural result on prices. A mature female sturgeon now often brings more than $150. The worst of the situation is the fact that all attempts at artificial propagation have failed; so that, unless prompt steps are taken to protect the sturgeon by law, this fish will be practically extinct in American waters in a very few years. The Commissioner recommends that the legislatures of all States in which this fish exists or has existed should absolutely prohibit its capture or sale for a period of at least ten years. Meanwhile the Bureau of Fisheries proposes to transplant into our waters young sturgeon from foreign countries; especially a species from the Danube and the Caspian Sea, specimens of which have been offered by the Roumanian government.

Sikorsky's New Record

A DISPATCH appears in the New York *Times* of February 27th to the effect that on February 26th last the Russian engineer Sikorsky's biplane carried seventeen persons in a flight of 18 minutes' duration.

This is the second machine that Sikorsky has built. Like its predecessor, it is huge, indeed by far the biggest flying machine ever constructed. No absolutely trustworthy dimensions have yet been published, nor have any really trustworthy details of the construction been given out. It seems certain, however, that the machine has a span of at least 80 feet, and that it is driven by four motors of 100 horse-power each. The passengers take up their places in an inclosed cabin of such size that seating and even sleeping accommodations are provided for some of them.

Wireless Weather Reports in the Indian Seas

WITH the rapid increase in the number and efficiency of the wireless telegraph stations on the coasts of India, it has now become practicable to issue daily weather bulletins by wireless to vessels over most of the Bay of Bengal and the northeastern part of the Arabian Sea. Six coast stations are open day and night, and any vessel-master can obtain the weather bulletin from the nearest of them on application. The importance of the new service is due to the fact that both of the seas in question are notorious for their cyclones. These are most frequent in spring and autumn, but are likely to occur at almost any time.

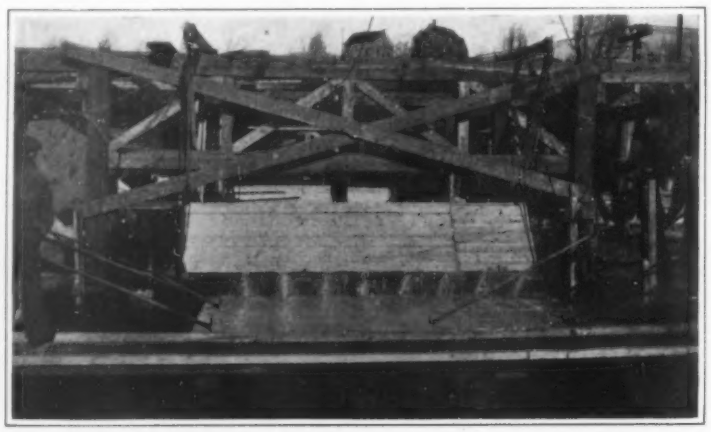
At Work on the Lincoln Highway

THE accompanying photograph is a 5-ton motor truck at work on the Pennsylvania State Highway. Construction is under way from Philadelphia to Pittsburgh, and when completed this road will be part of the coast to coast Lincoln Highway. Four and five trips constitute a day's work, a round trip averaging ten and one half miles. Loading time is about twenty minutes, as it is done by a gang of four men with hand shovels. The grades on this particular stretch of road are all the way from eight per cent to twenty-five per cent.

At work on the Lincoln highway.

Novel Method of Ice Sawing

IMPROVED methods of sawing ice are receiving increased attention to-day on account of the high cost of labor and large number of men needed to harvest a cut. A recent development in this field is shown in the accompanying photograph, which illustrates the application of the electric drive to multiple sawing in a channel located just outside the ice house. Instead of cutting the ice into small blocks on the lake surface and then poling it to the house at the risk of re-freezing, the ice is now cut on the pond into cakes 12 feet long and 18 feet wide, after which the cakes are put through the saws longitudinally and transversely, and are thus cut into 63 blocks per cake and fed into the house at the rate of about 5,000 tons per day of 10 hours. The saws are 36 inches in diameter and are run by electric motors mounted on a temporary platform at one side of the channel. A saving of about $100 a day is effected as compared with the old method of sawing on all parts of the lake, the reduction in labor and teams required being a striking feature.



Sawing large cakes of ice into smaller cakes for storage in the ice house.

Electrically-controlled Shutter for Automobile Headlights

TO meet the conflicting demands of motor car drivers and city authorities, the headlight shown herewith has been designed. It consists of two pairs of translucent wings mounted on pivots or bearings fastened in the headlight reflector. These wings are made to open and close by electro magnets situated inside the cover of the lamp itself. When running in the city, where it is necessary to use reduced light in the headlights and avoid glare, the wings are closed simply by pressing a push button conveniently situated on the dash. When the wings are closed, there is absolutely no glare, but the road near the car is flooded with strong, diffused light, a fact which makes the lamp particularly valuable when rounding sharp curves. At any moment when it is desired to use the full illumination of the lamp, it is only necessary to push another button which opens the wings, and the concentrated search light beam is at once available.

When in the folded or open position, the wings do not perceptibly affect the light given off by the lamps, as they are very thin and are so placed that they do not perceptably obstruct the rays of the headlights when folded. The electro magnetic control is extremely convenient, and it takes only a small current from the battery just at the moment when the wings are either opening or closing. The power required for operating the electro magnet is less than half that required by the average electric horn.

Headlight with reflector cut off.

Headlight with the shutter open.

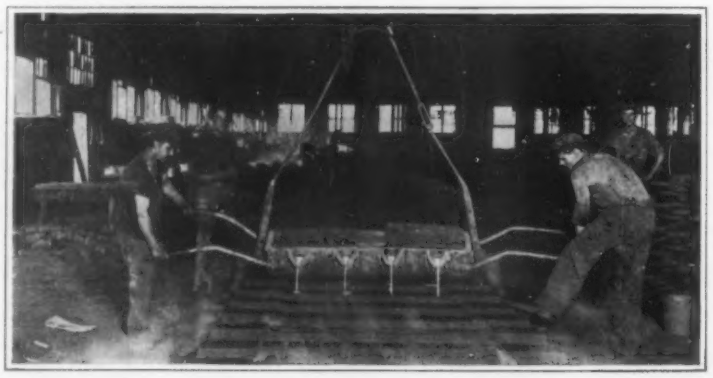
Modern Pipe Casting

AN interesting development in pipe-foundry labor-saving methods that has come into almost universal use at the present time is the subject of the accompanying illustration. This is a multiple-lip ladle so constructed that it pours from four points at once. Six foot gas and water pipe, and standard five foot soil or waste pipe has always been cast horizontally as in the picture, the multiple pouring having been used, as this gave a more perfect pipe. The shifting of cores and the consequent varying of wall thickness in the pipe was largely eliminated and a more perfect distribution of the liquid metal obtained. It was necessary, however, for the men who did the pouring to make a great many trips to the nearest source of supply of the molten iron, whether that was the furnace itself or the bull ladle, filled at the furnace and moved to the most advantageous points. The pouring also took a long time and more men could not be put on to hasten the process as they would merely get in each others' way. Each man could only carry a comparatively smal amount of iron, and the work that could be done was therefore limited in each instance by the physical capacity of the workman involved.

It was to get away from these closely limiting factors that induced the foundry operators to devise and develop the multiple-lip ladle for pipe pouring work. This ladle is built in the shape of a shallow, cast iron bath tub, lined of course, with fire clay to prevent its rapid burning out. It is supported at each end by a pin, pivoting in a bearing formed by the looped end of an arm that hangs from a chain hoist. The hoist in turn is supported on a trolley or craneway that is part of an overhead track system, centering at the cupola or furnace and extending over the floor space upon which the casting is done.

These ladles are filled directly from the cupola and will hold half a ton or more of iron. The workmen are protected from the great radiated heat of the molten iron by shields either fastened to the supporting arms, or, as in the picture, covering the ladle itself. Long handles attached to each side of the ladle at its opposite ends provide means for tilting and guiding the ladle so that it will deliver the iron through the four lips into the proper openings provided in the top of the pipe mold.

Pocket wireless receiver for time signals.



Pipe casting with a multiple-lip ladle.

Vest Pocket Wireless Receiver

THE value of the new French "ondophone" detector, for receiving wireless signals, lies in its very small size and compact make-up, so that the whole affair can be carried in the vest pocket. It is designed to meet the growing demand among the public for a device which will enable anyone to hear wireless time signals from the Eiffel Tower station. When it is once appreciated that the time signals can be taken without the use of a complicated device, and with little knowledge of electricity, there is no doubt that a much more general use will be made of the wireless time signal system. To show what can be done with the little detector, we may mention that at 20 miles from Paris, all that is needed is an open umbrella held as high as the arm can reach, while a small metal contact piece attached to a cord lies upon the ground and makes the earth connection. At 60 miles, one plants a knife in a tree, preferably a pine tree, or a gimlet will answer as well. One of the cords with its metal clip is joined to this "antenna," while the other clip is placed on the ground. The entire receiver weighs but 13 ounces, and yet, in spite of its small size, it is carefully made and is an apparatus of great precision. For long distances, to the extreme borders of France for instance, and even farther, one clip is joined to a telephone line which serves as an antenna, and the other goes to gas or water pipes for the ground. But within 120 miles, all that is needed for the antenna is a kitchen stove or range, balcony, metal bed and the like, and even a bicycle on the road makes a good antenna, or an automobile. The operator may use his body for the ground by attaching the metal clip to his finger, while the other clip goes to the telephone wire. In this way signals were received from Paris at a distance of 270 miles.

A Danish Typewriter Contest.—In a typewriting contest held at Copenhagen, at which machines from leading manufacturers were entered, there were sixty-nine competitors, and about forty of the operators contesting for prizes used American machines. It is interesting to note that the first, second and third prizes were all won on American typewriters, and only two contestants using machines other than American succeeded in receiving mention.

How the Locks of the Panama Canal are Operated

The Wonderful Control Boards Which Enable a Single Man to Operate Gates Weighing Tons and to Govern the Course of Thousands of Gallons of Water

THE mechanism which will operate the ponderous locks at Gatun, Miraflores and Pedro Miguel in the Panama Canal, is quite unlike anything used elsewhere in the world. Heretofore it has been the practice to distribute a large operating force practically along the full length of the locks in a canal. Such a force is difficult to co-ordinate into an efficient operating system. Moreover, the enormity of the Panama locks made it highly desirable that all operations should be centralized. The flight of locks at Gatun, for example, extends over a distance of 6,152 feet, and the principal operating machines are distributed over a distance of 4,115 feet.

The Isthmian Canal Commission decided that the locks must be electrically controlled from some central station in each case, because thus the number of operators, the operating expense, and the liability to accident could be reduced. Great electrical control boards have therefore been especially invented which are installed at Gatun, Miraflores and Pedro Miguel—control boards which are so ingeniously conceived and constructed that a single man, who need never see the ships which are passing through the canal, opens and closes lock gates weighing many tons and governs the course of thousands and thousands of gallons of water.

How the Locks Are Arranged.

Before we can understand how this is done, we must explain how the locks themselves are constructed and what is the character of the lock machinery to be controlled.

As readers of the SCIENTIFIC AMERICAN know, the lock chambers are 1,000 feet long. At each end of a lock chamber, so-called "mitering gates" are to be found, which consist of two massive leaves pivoted on the lock walls and which operate independently of each other. Immediately beyond each pair of mitering gates at each end of a lock chamber a duplicate pair of mitering gates is to be found. These are guard gates. Lastly, still other mitering gates open and close within the lock chamber itself. These, which are called "intermediate mitering gates," are used to divide the 1,000-foot locks into smaller compartments when vessels of short length are to be handled. Thus much water is saved. All the mitering gates, when closed, are clamped tightly together by a device called a "miter forcing machine."

In front of all the mitering gates which are exposed to the upper lock level and also in front of the guard gates at the lower end are chain fenders. These chains are taut when the gates behind are closed and are lowered when the gates are opened for the passing of a ship. The chains are raised and lowered by a method similar to that followed in hydraulic elevators, with the additional feature that if a ship approaches the gate at a dangerous speed and runs into the chains, the chain is paid out in such a way as to stop the ship gradually before it reaches the gates. Two motors lower the chains for the passage of a vessel and raise it again after the vessel has passed. One motor drives the main pump supply water under pressure, and the other operates a valve which controls the direction of movement of the chain. These two operations are combined in one, each motor being stopped automatically by a limit switch when the motor has performed its function.

How the Water Flows from Lock to Lock.

The locks are filled and emptied by three culverts, one in the middle wall and one in each side wall. The flow of water is controlled by what are known as "rising stem valves." These valves are located in the culverts at points opposite each end of each lock, so that the culvert can be shut off at any desired point for filling a lock with water from above, or upstream, or for emptying it by allowing it to flow out and down to the next lock. Lateral culverts conduct the water from the main culverts under the lock chambers and up through openings in the lock floors.

The rising stem valves are installed in pairs, and each pair is a duplicate. Moreover, each culvert is divided into two parallel halves at these valves by a vertical wall. This arrangement reduces the size of each valve, so that it may be more easily operated. Even then, each valve measures 8 by 18 feet and is raised and lowered by a 40 horse-power motor requiring one minute for complete closing. One pair of duplicates is left open as a guard or reverse pair; the other pair is used for operating, so that in case of an obstruction in the culvert or of an accident to the machinery, the duplicate pair can be used.

At the upper ends of the culverts at the side walls, the duplication is accomplished by three valves in parallel, called the guard valves. Their service is exactly similar to that of the rising stem valves, except that three valves in parallel in this case must conform with the same laws as the two in parallel in the other case.

The culvert in the middle wall must serve the locks on both sides, and to control this feature, cylindrical valves are placed in the lateral culverts that branch out on each side. There are ten of these on each side of the culvert at each lock.

At the upper end of each set of locks, there are two valves in the side walls for regulating the height of water between the upper gates and upper guard gates, as it is desired to maintain the level of the water between these gates at an elevation intermediate between that of the lake above and that of the upper lock when the upper lock is not at the same level as the lakes. These valves are called the auxiliary culvert valves.

Five Hundred Motors Operate the Lock Mechanism.

To give an idea of the number and sizes of the motors to be controlled in operating the lock machinery it may be mentioned that each miter gate leaf is moved by a 25 horse-power motor. There are forty such motors at Gatun, twenty-four at Pedro Miguel, twenty-eight at Miraflores, a total of ninety-two, with an aggregate horse-power of 2,300. Each miter-gate forcing machine is worked by a 7 horse-power motor. Of these motors there are twenty at Gatun, twelve at Pedro Miguel, fourteen at Miraflores, a total of forty-six, with an aggregate horse-power of 322. So, at Gatun, Pedro Miguel and Miraflores there are in all forty-eight motors of 70 horse-power each, which work the main pumps of the fender chains and which have an aggregate horse-power of 3,360; forty-eight motors of ½ horse-power each for operating the valves of the various fender chains and which have an aggregate horse-power of 24; one hundred and sixteen motors of 40 horse-power each which operate the rising stem gate valves; one hundred and twenty motors of 7 horse-power each which operate the cylindrical valves; eighteen motors of 25 horse-power each, which operate the guard valves; and twelve motors of 7 horse-power each which operate the auxiliary culvert valves. Hence, there are five hundred motors of various kinds at Gatun, Pedro Miguel and Miraflores, with an aggregate horse-power of 12,020, to be controlled.

The Wonderful Electrical Control Boards.

The electrical control boards which control all these many motors, valves, and pumps were designed and built at Schenectady, New York, from specifications prepared under the supervision of Mr. Edward Schildhauer, electrical and mechanical engineer of the Isthmian Canal Commission, ably assisted by Engineers C. B. Larzelere, W. R. McCann, and others, and will long be used as models of skilled and painstaking engineering in which every contingency was foreseen and all the safeguards installed that expert engineers could suggest.

The control boards for each lock are to be found in control houses located on the middle walls at points which afford the best view of the locks, although this view is not depended upon to know the position of the gates or other apparatus.

The control boards are approximately operating miniatures of the locks themselves. They have indicating devices which always show the exact position of valves, lock gates, chains and water levels in the various lock chambers, and so far as was necessary are synchronous with the movement of the lock machinery.

The control boards are flat benches 32 inches high by 54 inches wide, built in sections. The board at Gatun is 64 feet long; that at Pedro Miguel 36 feet long and that at Miraflores 52 feet long.

The side and center walls of the locks are represented on the board by cast iron plates and the water in the locks by blue Vermont marble slabs.

The Indicators and How They Work.

In designing the indicators efforts were made to represent the actual machines, the operations of which were to be indicated. For example, the chain fender index consists of a small aluminium chain representing the larger chain of the lock itself. Just as the large chain is lowered into a slot in the bottom of the lock, so the small chain is lowered into a slot in the top of the board. With equal fidelity the miter gate is reproduced. The miter gate indicator consists of a pair of aluminium leaves or pointers which represent a pair of the large miter gates and which move in a horizontal plane just above the marble slab representing the water in the lock. The rising stem valve indicators, however, presented a more serious problem, because the valves themselves are located in a culvert and the operating machinery is concealed below the lock wall; yet for the purpose of observation it was necessary that the indicators project visibly above the surface of the board. The rising stem gate valves of the locks, it has been stated, occur in pairs. For that reason the indicators for these valves have likewise been made in pairs on the board. Each of these indicators may well be likened to a miniature elevator, the car being used to indicate the position of the valve gates. In order that the indication might be visible from various points up and down the board, a novel scheme was resorted to. The underside of the car is equipped with reflectors so arranged as to reflect, parallel to the surface of the board, the light of several incandescent lamps located underneath the board. This light is reflected through openings in the indicator facing both up and down the board, the openings being closed with opal glass. The reflected light gives a sharp shadow on the bottom edge of the car, all portions of the indicator above this line being dark and all portions below being illuminated. The illuminated portions show how far the gate of the valve is open. If the indicator is dark, the valve is entirely closed; if the indicator is illuminated, the valve is entirely open. The one quarter, one half, and three quarter positions of the gate are indicated by heavy black lines on the glass.

For the water level indicator, great accuracy was required. The specifications demanded that the level of the water be indicated to within five eighths of an inch of the actual level, but the indicators attained an accuracy somewhat greater than this. The height of the water is indicated by a rising and falling hollow cylinder having pointers which move over scales. The scales are illuminated by tungsten lamps, located in both the base and the top cap of the indicator.

The indicators for the miter forcing machines, which force the end surfaces of the lock gates into alignment, are not operated by means of position indicator machines. Since all the operator cares to know about them is whether they are in the open or closed position, they are operated merely by control switches.

The open and closed positions of all cylindrical valves are indicated by means of red and green lamps, the intermediate positions not being indicated in any way because the operators need not take cognizance of them.

The Interlocking System, Which Prevents Mistakes.

In order to make it necessary for the operator to maneuver the control switch handles always in a certain order, corresponding with a predetermined sequence of operation of the lock machinery, and to prevent the operator in control of one channel from interfering with the machinery under jurisdiction of the operator controlling the other channel, an elaborate interlocking system has been devised.

The limitations of space forbid an elaborate description of this wonderful interlocking mechanism. The interlocking system is essentially a bell crank mechanism, connecting the shaft of the control switch directly to a movable horizontal bar, forming one of many such bars in an interlocking rack below the control board.

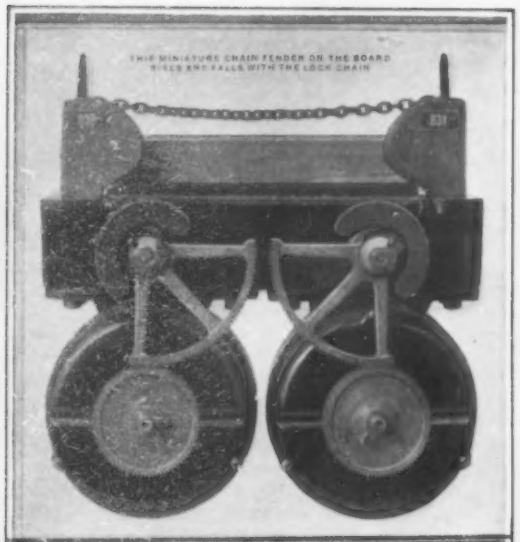
From one of the accompanying detailed illustrations it will be seen that a horizontal connecting rod is used between the cranks on the control switch shaft and the vertical operating shaft. The interlocking rack consists of a rigid frame constructed of three eighths inch thick steel and having five horizontal members. Upon these horizontal members and tying them together are located at convenient intervals a set of vertical straps of three eighths inch by two inch steel. These carry the brass posts that provide the runways for the horizontal and vertical interlocking bars.

The back of the steel strap is grooved and countersunk in such a manner that a key is provided which prevents turning of the posts.

The interlocking system depends mainly on the action of engaging bevel dogs located on the horizontal and vertical bars, the movement of a horizontal bar tending to lift a vertical bar by bevels on the dogs. A horizontal bar cannot be moved without raising a vertical bar. Thus, if at any time a dog on a horizontal bar rests against the upper end of a dog on a vertical bar, no movement of the horizontal bar where the dog engages the vertical bar can take place, and the control handle connected with that particular horizontal bar is locked.

The interlocking system forces the attendant to operate the chain fenders, gates and valves always in the proper sequence, and also prevents him from operating

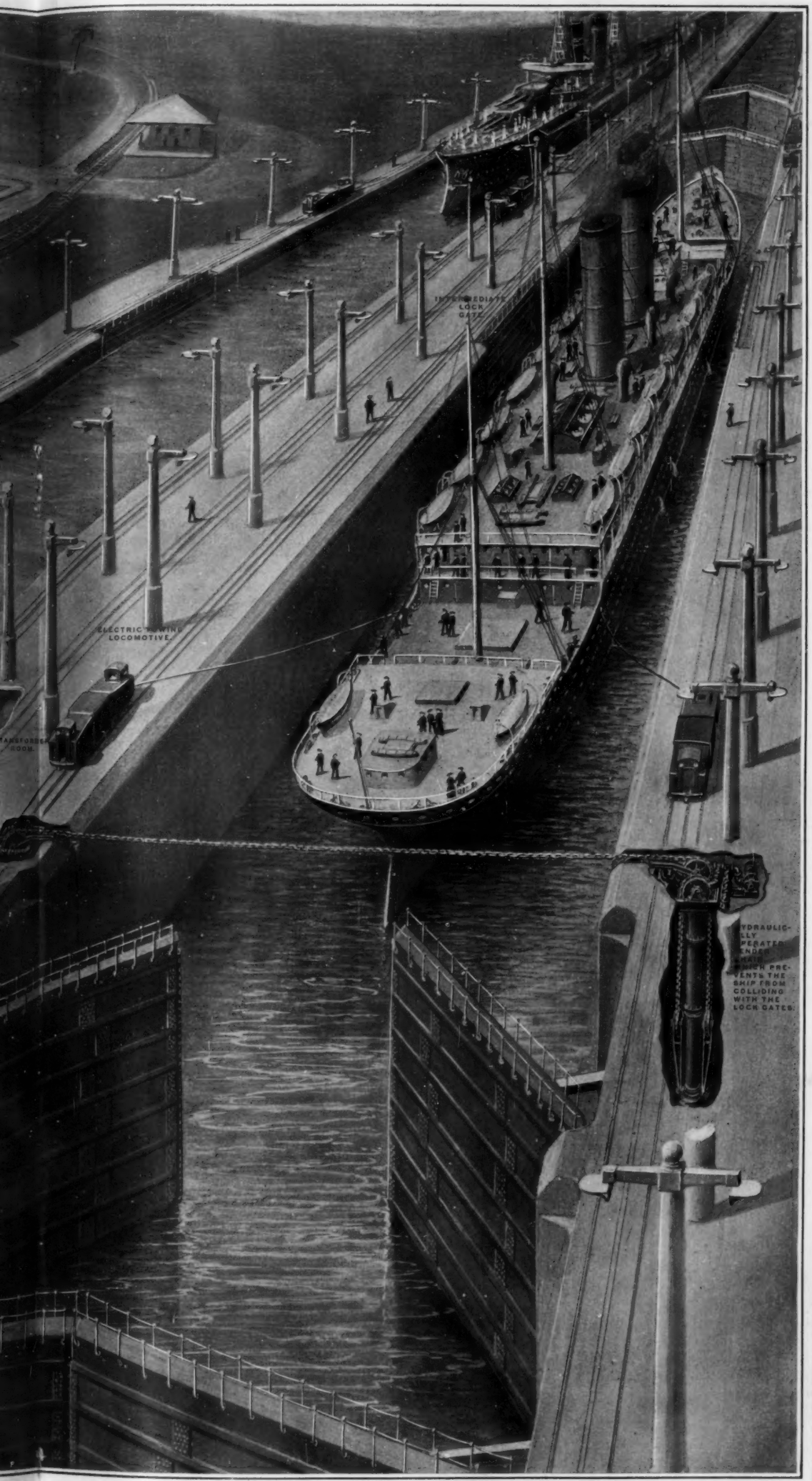
(Concluded on page 214.)



The indicating devices on the control boards show the positions of the rising stem and other valves, lock gates and the water level as it changes in the various locks and in the forebay.

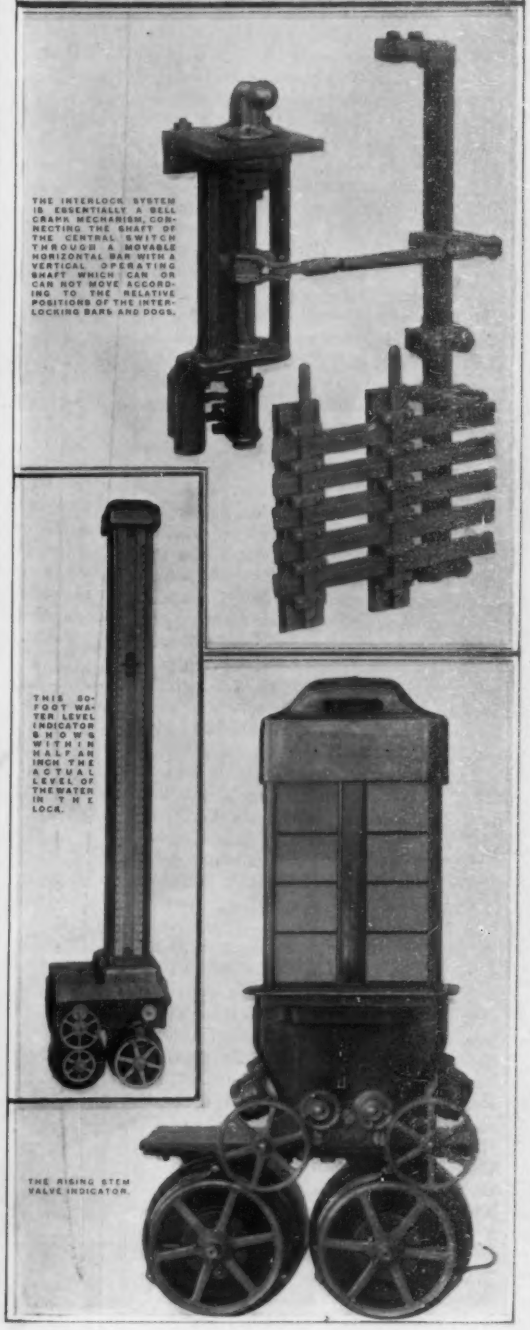
The machinery of the three locks at Gatun, Miraflores and Pedro Miguel will be electrically operated from control boards. The b ates ponderous gates weighing tons, and governs the course of millions of gallons of water. The control boards are the first of thei

HOW THE LOCKS OF THE PANAMA



ards. The boards are reproductions in miniature of the locks they control. A single man by turning a few switch handles oper- first of their kind in the world, and they will long be regarded as models to be followed and as marvels of inventive ingenuity.

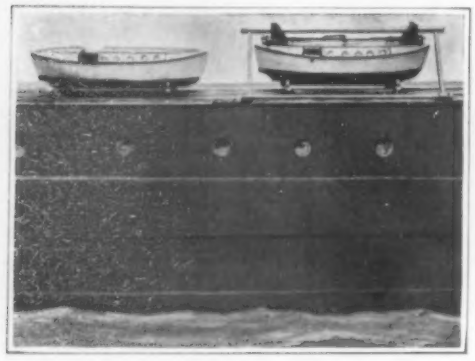
E PANAMA CANAL ARE OPERATED



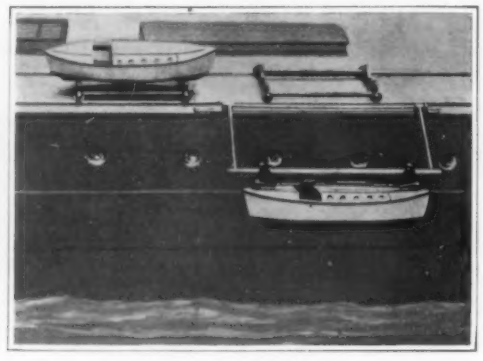
In passing a vessel through any lock the control board operator, by an ingenious interlocking system, is compelled always to manipulate the operating levers in a definite order. He cannot make a mistake.

Inventions New and Interesting

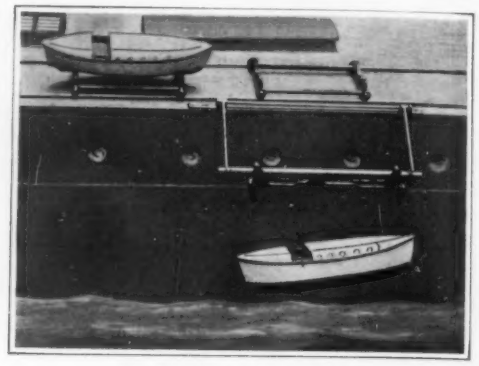
Simple Patent Law; Patent Office News; Notes on Trademarks



Picked up by the crane.



Waiting for a favorable wave.



A sheer drop of ten feet.

A Motor Lifeboat With a Cabin

NO matter how safe a vessel may be rendered by means of bulkheads and double bottoms extending well above the waterline, the danger of fire, of a boiler explosion or of pounding to pieces on rocks or shoals makes it essential that every vessel be fitted with lifeboats. Recent disasters at sea show how difficult it is to launch a lifeboat of the ordinary type from a vessel in time of storm and also how readily the ordinary open lifeboat may be swamped. At the recent Motorboat Show held in New York a motor lifeboat was exhibited which was identical in design with the self-righting, self-bailing motor lifeboat used in the United States Life Saving Service, with the additional feature of a completely inclosed cabin. The boat is 36 feet long and provided with a 35 to 40 horse-power internal combustion engine capable of driving it at a speed of 10 to 11 miles per hour, fully loaded. The engine which may be operated on gasoline, kerosene or distillate fuel is placed in a water-tight compartment in the stern with all the controls on the outside, so that there would be no chance for the engine to be overwhelmed by a wave. Furthermore, the smoke and engine smells are kept out of the cabin. The gasoline tanks are on the outside and above the waterline where any leak would drain overboard. Into the cabin 60 or 70 passengers may be crowded and kept where their frantic and hysterical actions will not bother the pilot of the boat. In addition to the engine the boat is provided with a wireless telegraph system whereby communication could be established with rescue ships.

As the principal danger lies in the launching of a lifeboat, the builders of this lifeboat had designed a simple launching system, the rudimentary principles of which are shown in the accompanying illustration. On the boat deck a system of tracks is laid and the lifeboats are supported on roller trucks which run along the tracks and are thus brought to the launching point on the leeward side. Here they are picked up by a simple crane consisting of a pair of arms fulcrumed at the side of the vessel and connected at their outer ends by a cross-arm. By means of an automatic clutch the boat is instantly secured to the cross-arm and then the crane is swung out over the side of the vessel, coming to rest with the keel of the lifeboat about 15 feet lower than the boat deck. Here the lifeboat is supported far enough out to prevent it from being smashed against the side of the vessel. The pilot then awaits his opportunity. As soon as a wave dashes up to within 10 feet of the keel of the lifeboat he operates a release lever which drops the boat into the water. The lifeboat is so stanchly constructed that it may take a drop of 10 feet or even more without injury. As soon as it strikes the water it is carried off from the boat by the receding wave, and the engine which previously has been started, immediately carries it clear of the wreck. In case conditions do not permit of dropping the boat directly into the water, an inclined monorail system has been designed which may be attached to the side of the boat in such manner that it may fold against the hull or may be extended, when desired, so that it will form an extension of the cross-arm of the crane. Down this inclined monorail the boat glides under control of the operator until it reaches a point where it may be dropped into the water. It is impossible for us to judge of the practicability of these proposed launching methods as we have not been acquainted with the essential details. The boat, however, whether launched in this manner or by well-known methods now in use, should prove almost invaluable in case of a serious accident at sea.

A self-righting, self-bailing, motor lifeboat with cabin accommodating sixty passengers.

The Molecular Air Pump

A GREAT deal of interest has recently been aroused in the introduction, by Dr. Gaede, of an interesting type of air pump. It has particular value in connection with the exhaust of gases from bulbs, tubes, and similar apparatus requiring a high internal vacuum.

The principle of the apparatus is shown in Fig. 1. *A* is a cylinder fixed on a shaft *a* and inclosed in a casing *B*, into which is cut a groove reaching from *n* to *m*. When the cylinder *A* rotates as shown by the arrow, the air contained in the groove is entrained from *n* to *m* by the friction. On connecting a gage *o* to the apertures *m* and *n* by pieces of rubber tubing *S*, it shows a difference of pressure between *m* and *n*. The level of the mercury rises to the point *p* and is depressed to *o* at the other end. The difference of pressure is proportional to the number of revolutions of the cylinder *A* and the internal friction of the gas.

This internal friction, according to the kinetic theory of gas, is produced by the collisions continually occurring between the moving molecules of the gas. The molecules move with a very high velocity in rectilinear paths, the direction of which is absolutely irregular until they meet with other molecules. At ordinary pressure the result of this is an irregular, zigzag motion. At very low pressures, however, the collisions of molecules among each other become very rare owing to the high degree of rarefaction, so that the molecules of the gas may be said to impinge exclusively on the walls of the vessel containing them. From the walls the molecules are reflected quite irregularly, the angle of reflection being independent of the angle of incidence. If the surface of the cylinder *A* moves with a higher velocity than the molecular velocity of the gases, the effect of vessel moving to the right with a higher velocity than that of the molecules projected out of it to the left is that the molecules projected toward the point *n* are nevertheless entrained to the right in the direction of the arrow in the figure. No molecules reflected from the cylinder will therefore reach the aperture, which will be a region of fewer molecules—in other words, a vacuum will be formed at *n*.

Evidently this pumping arrangement is not so useful at atmospheric pressure as at low pressure in connection with a backing or rough pump, as the action of the pump is based on the molecular action of the gases. Figs. 2 and 3 show the actual construction of the cylinder *A* fixed on the shaft, *a* in the case *B*. The shaft runs in bearings provided in the end-plates *E* of the cylindrical casing which are screwed on air-tight. The grooves *D* are cut into the cylinder, and the tongues *C* which are fixed on the casing project into the grooves. *F* are the oil tanks, *G* is an adjusting gear by which the tongues *C* are kept from touching the rotating walls of the grooves. *H* is the pulley. When *A* rotates clockwise, the air is compressed at *m* and rarefied at *n*. The extension *K* is fixed by screws on the casing *B*, forming an air-tight joint. *S* is the suction nozzle which communicates with the space *n* in the casing, the groove *D* shown in the cut being the central groove of the pump. The discharge air pressure opening *m* of this groove is connected with the suction opening of the adjoining groove by a channel bored in the extension *K*, the pressure opening of the

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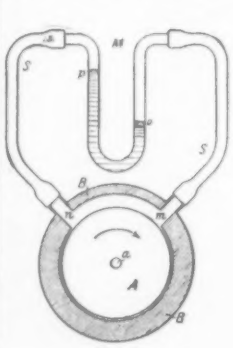


Fig. 1.

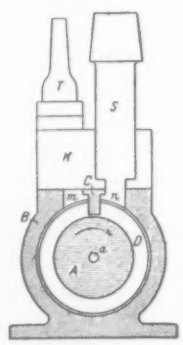


Fig. 2

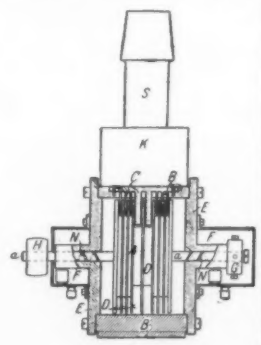


Fig. 3.

Diagram and sectional views of the new vacuum pump.

Fig. 4.—General view of the molecular pump.

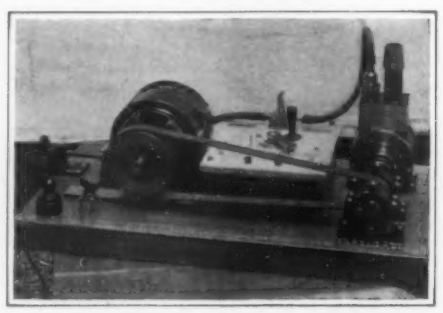


Fig. 5.—Pump belted to a motor which drives it at 8,000 to 12,000 revolutions per minute.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

ADJUSTABLE BANDEAU FOR LADIES' HATS.—B. WERTHEIMER, care of F. F. Eiseman, 41 Park Row, New York, N. Y. This invention provides an adjustable bandeau for ladies' hats, arranged to enable the milliner or other person to readily increase the size of the bearing portion of the bandeau to suit the head of the customer, thus insuring a proper fit of the hat.

CORSET COVER.—L. T. FURNAS, Lima, Ohio. This invention refers to a garment in the form of a corset cover or brassière which is adapted for contraction or expansion at both top and bottom and intermediately on a vertical median line for giving a desired contour to the bust and waist.

Pertaining to Aviation.

AEROPLANE.—A. E. HOLBROOK, Joplin, Mo. The purpose here is to provide a machine wherein a maximum of lifting surface is obtained with the smallest possible amount of weight, wherein the balancing will be automatic, and wherein a plurality of rudders is provided operated by a single shaft.

FLYING MACHINE.—R. M. METCALF, Route 3, Valley City, N. D. This invention relates to a flying machine of that type known as self-propelled aeroplanes; and the aim is to provide a device which will be simple, of light weight and great strength, which will run at a high speed and in a steady manner, and which will be capable of easy control.

Of Interest to Farmers.

CULTIVATOR.—R. DINSE, Stanwood, Iowa. The object here is to provide a device by means of which plants in rows may be cultivated on all sides, while the cultivator is moving longitudinally of the rows, thus dispensing with the necessity for hoeing or cultivating at right angles to the direction of the rows.

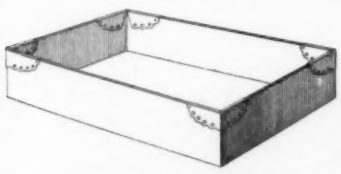
LINE GUIDE.—A. C. OHNSMAN, care of J. L. Ohnsman, Sta. A, Route No. 5, Columbus, Ohio. The object here is the provision of easily transportable means for holding a line at each end of the field to be planted, so arranged that the line will be held tight during the planting, and when the row is planted the succeeding line will be indicated.

ELECTRICAL AGRICULTURAL SYSTEM.—C. S. DONEY, Wallace, Idaho. This invention provides a means for supplying power to agricultural tractors or motor vehicles such as gang plows, cultivators, seeders and the like, which will permit them readily to move over the ground. It provides means whereby a trolley on the motor vehicle will move the wires from which it receives current to and fro as the tractor traverses the field.

WIRE WINDER.—C. B. RUBY, Le Mars, Iowa. The inventor provides a device wherein means is provided for holding and rotating a reel, together with means capable of being operated from a point adjacent to the reel, for constraining the wire to wind in uniform layers upon the reel. When taking down a fence, the frame may be moved as a sled or with wheels, winding up the wire as the device moves along the fence.

Of General Interest.

BOX CORNER PROTECTOR.—KATHERINE M. BLACK, 407 E. 11th St., Austin, Tex. This protector is constructed of a piece of metal with an angular cutaway portion at its inner side so that the piece of metal may be bent longitudinally and transversely through the apex of the angle formed by the cutaway portion to fit a corner of the box or box lid without the inner side of the piece of metal over-



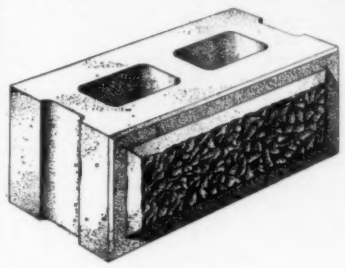
BOX CORNER PROTECTOR.

lapping. The edge of the piece of metal is scalloped, and the edges of the scallops are turned inward to engage the surfaces of the sides of the box to obtain a grip thereon and prevent protruding edges of metal from catching goods in the box. The outer sides of the metal have punched portions forming spurs which project inward and which engage similar spurs on the inner sides of the metal, which project outward.

MOLD FOR EARTHENWARE.—A. FOLTZ, Lambertsville, N. J. Address L. P. Kugler, same place. An object of the inventor is to provide a device by means of which an article, such as a tank, may be molded by passing a stream of water containing particles of clay or other suitable materials in suspension, into the mold, where the clay is deposited, the water being forced out by pressure.

TABLET.—W. K. WATERMAN, 12 South 18th St., Flushing, New York, N. Y. This tablet is for use on the outside of office buildings, stores, banks, etc., and arranged to be legible during the day and night by evenly illuminating the panel or background to render the opaque letters distinctly visible, project but little from the face of the structure to which the tablet is attached, and to give the tablet an exceedingly artistic appearance.

BUILDING BLOCK AND METHOD OF FORMING THE SAME.—F. AARONSON, Manasquan, N. J. This invention provides blocks with undressed faces; provides said blocks with roughened faces, such faces being formed



BUILDING BLOCK.

without design; provides a molded block having an unmolded face and provides a block having a face roughened by forcibly separating said face from a body of the same material, The grain of the material, instead of being, as at present, closed or filled, has much of the porosity of fracture lines of a natural rock.

MOUSE PROOF PIANO PEDAL.—R. BOLLERMAN, care of Bollerman & Son, 271 E. 132nd St., Bronx, N. Y. This invention has particular reference to means for effectively excluding mice from the interior of the piano. The invention provides a means for use in connection with a piano pedal which will automatically close the opening ordinarily left by the pedal when in its normal elevated position.

TRUSS.—J. T. HAILE, Utopia, Tex. The invention provides certain improvements with respect both to the truss pad and the adjustable connections for securing the same to the wearer, whereby to form a more sanitary, more comfortable and more beneficial device than is now in use.

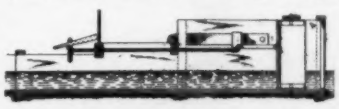
ELEVATED CARRIER.—A. D. HADSEL, care of Cable Excavator Co., 410 Arcade Bldg., Philadelphia, Pa. This carrier includes a cableway which may be of considerable length and along which is adapted to be operated a main carriage for the purpose of supporting any suitable form of excavator bucket or means for handling material in general, including the loading and unloading of barges or other craft or transfer of vessels to cars or handling of stone in quarries or the like.

COMBINATION WRITING PAPER AND ENVELOP TABLET.—J. ANDERSON, U. S. S. "Utah," care of Postmaster, New York, N. Y. The invention relates particularly to a tablet in which sheets of writing paper and a series of envelop blanks are so combined that the paper and the blanks have a compact and convenient arrangement, with the blanks spread out in flat form and superposed one on another, the paper and the blanks being held to stubs defined by lines of perforations or their equivalent, so that the letter sheets and blanks can be readily detached as required for use.

PROCESS OF MOUNTING EYE SPECIMENS.—F. L. BARROWS, Moscow, Idaho. The process consists in placing fresh eyes (preferably pig or sheep) for mounting in a formalin solution to harden the same, then freezing and dividing them into two parts; keeping such parts immersed in an aqueous solution until the vitreous portion has dissolved out and gelatin has taken its place; then removing the eye portions and immersing them in soft gelatin to solidify.

HOLDER FOR PACKING BOXES.—NETTIE C. LYND, Oregon City, Ore. An object of this invention is to provide a holder for packing-boxes such as boxes or crates used in packing oranges, grape fruit, or other fruit which will obviate the necessity of lifting the box and turning it around during the packing operation.

HEAD GATE.—J. T. FITCH, Helper, Utah. The object of the invention is to provide a simple, strong, inexpensive and balanced gate which can be quickly and easily operated and which is provided with means for indicating the size of opening formed by the gate. This invention provides a gate adapted to swing in a plane normal to the flow through the gate,



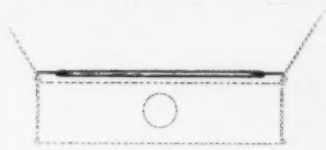
HEAD GATE.

with means for swinging the gate and means indicating the size of opening made by the gate. The gate being centrally pivoted in a vertical axis, the pressure of water in the gate at any position of the gate is necessarily balanced; thus no extra power is required to operate the gate.

NON-REFILLABLE CIGAR BOX.—J. GAGLIANO, 122 Jamaica Ave., Astoria, N. Y., N. Y. This invention provides means for handling or dispensing the better grades of cigars, cigarettes or the like. It provides a means whereby cigars may be handled in bulk in such form that the individual cigars cannot be touched or handled, and hence are kept in a perfectly clean and sanitary condition.

HORSE OVERSHOE.—J. J. O'CONNELL, R. F. D. No. 1, Box 119, Ridgewood, N. J. The invention pertains to farriery and has particular reference to a temporary attachment or overshoe to be applied in slippery or icy weather to prevent the ordinary horseshoe from slipping when the calks thereof, because of being blunt or otherwise, will not hold the horse securely.

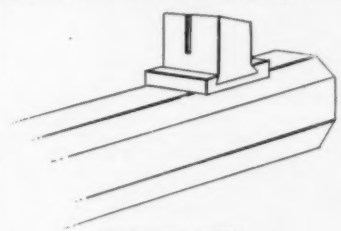
STRAINER ATTACHMENT.—G. BENDIX, Vesta, Minn. The purpose here is to provide a device whereby a strainer for milk or other fluids may be quickly repaired without the necessity of dismantling the device. The article may be used with an ordinary milk strainer



STRAINER ATTACHMENT.

and its use will practically render the strainer as good as new. An annular ring with the screen or wire cloth is made up in various sizes to accommodate strainers of greater or less capacity. The rings are made full width so that they may be trimmed if necessary. Ordinarily, however, this would not be required.

FRONT GUN SIGHT.—A. J. EVANS, Box 157, Mosier, Ore. The purpose of this sight is to secure greater accuracy in elevation and line in target and game shooting. It is of the type of leaf or block sights having a notch or vertical slot in the center. In practice, when the sight is used on military and sporting guns, the surface next to the eye should



FRONT GUN SIGHT.

be finely matted or black. The sight permits an unobstructed vision of the bull's eye or target, and in raising the gun, the horizontal line of the top of the sight quickly indicates the required elevation, while the vertical slot quickly directs the vision in line with the objects.

CAPSULE.—M. H. SMITH, 105 Chamber St., New York, N. Y. This capsule is provided at its inner face with a raised identification mark of the same material as the capsule and integral therewith, the capsule being filled with a liquid medicine having approximately the same index of refraction as the capsule so that the identification mark is not discernible from the outside.

PROCESS OF PRODUCING A PHOTOGRAPHIC REPRODUCTION FOR USE IN MAKING BAS-RELIEF.—G. M. CARPENTIER, 175 W. 95th St., New York, N. Y. This invention relates to a process for producing photographic reproductions in relief of designs, paintings, engravings, or photographs of any description with absolute fidelity of form and in any given size of the objects or figures the artist intended to represent.

Hardware and Tools.

PNEUMATIC TOOL.—E. M. TOBIN, Barre, Vt. The invention relates to improvements in pneumatic tools, and particularly to what are known as pneumatic hammers, and has for an object to provide a structure wherein the various moving parts are reduced to a minimum, and the action is without unnecessary vibration or jars.

DENTAL MASSAGE IMPLEMENT.—M. POUNDER and F. F. HANSKE, Munger Bldg., Elkhart, Ind. The object here is to provide an inexpensive implement which may be used to massage the gums of the oral cavity to provide and stimulate healthy circulation of blood in the gums and by these means prevent and cure various diseases of the gums, including congested and receding gums.

SCREENING-SHOVEL.—O. THIBAULT, Box 548, Fall River, Mass. In this instance the invention is an improvement in the class of shovels adapted for screening or sifting cinders, coal, and other like commodities. The shovel-blade is formed of wrought iron or steel struck up in dies into the required form, and it may be cheaply and easily produced by means of cutting and shaping dies.

HINGE.—W. N. BLANCHARD, 2215 Gaty Ave., East St. Louis, Ill. The object here is to provide a hinge for general use, wherein the principal portion of the mechanism is arranged within the members to be hinged together, and means is provided in connection with the said mechanism for engagement by a cover, hood or blind to conceal the joint and the hinge.

BELT FASTENER.—J. EVANS, JR., and JAMES EVANS, care of W. P. Davis, 909 W. North Temple St., Salt Lake City, Utah. The invention pertains to fasteners in which a plate is provided with spaced fingers comprising, in general, the form of a club plate, the fingers being designed to be passed through holes adjacent to the meeting ends of the belt, the free ends of the fingers having means for preventing their accidental withdrawal.

UNDERREAMER.—G. A. MONTGOMERY, Box 76, Oilfields, Cal. This invention is for use for enlarging a drill hole previously formed with an ordinary club bit in drilling for crude oil, and provides a large area of wearing surfaces between the cutters and their supporting elements; provides a construction in

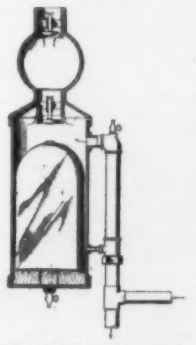
UNDERREAMER FOR ENLARGING DRILL HOLES.

which these surfaces will be largely protected against the entrance of abrasive matter; provides perfect seats for the cutters; makes provision for preventing the losing of the reamer cutters; promotes convenience in adjusting the reamer in position to be lowered into the well, and provides an underreamer, the body of which is free from subjoints.

CIGAR TUCK CUTTER.—G. W. ROWMAN, 409 S. George St., York, Pa. The general object in this case is to improve the construction of the retaining device and guard so as to be more flexible and engage the cigar when in position to be cut with just enough pressure as to hold it in co-operative relation with the cutters without danger of breaking the cigar which will effectually prevent the cigar being held by the operator while being cut.

Heating and Lighting.

VALVE FOR VACUUM HEATING SYSTEMS.—A. PORTER, Marquoketa, Iowa. An object of the inventor is to provide a steam heating system in which a vacuum is obtained by the condensation of steam, air being prevented



VALVE FOR VACUUM HEATING SYSTEMS.

from entering the pipes by an air valve of special construction. A further object is to provide means for permitting the escape of air when the steam pressure rises above atmospheric pressure.

SELF LOCKING LAMP BULB.—C. BLASS, 312 Milford St., Brooklyn, N. Y. This invention relates to electric lighting devices and has particular reference to a means for preventing the unauthorized removal of incandescent elec-

SELF LOCKING LAMP BULB.

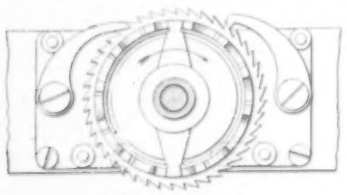
tric lamps from their sockets, a source of a great deal of annoyance and financial loss incident to the use of such lamps in public places. Locking means co-operate between the lamp base and its socket, which operates automatic-

ally to secure the parts together and which requires a special form of key for unlocking.

LIQUID FUEL BURNER.—G. E. DENMAN, 3558 Custer St., Fruitvale, Cal. This invention has reference more particularly to the class of device comprising an inner and an outer casing having independent inlets, one for fuel and the other for the compressed fluid, and a tip body secured to both of said casings and through which the liquid fluid is forced by means of compressed fluid.

OIL BURNER.—J. A. TRIMBLE and C. H. MILLER, 5433 36th Ave., S. E. Portland, Ore. The inventors have found in practice that the burner is very efficient, and the advantages obtained are due to heating the air and other gases before they enter the mixing chamber, so as to raise the temperature of the oil and make the same readily ignitible. They thus accomplish a great saving of fuel, besides the uniform flame and even heating effect which the burner affords.

CRANKING DEVICE.—T. MCCABE, Homestead, Pa. This device is for use on gas or gasoline engines. An object of the inventor is to provide a device especially adapted for use on automobiles and gasoline engines, the construction being such that the brakes must be



CRANKING DEVICE.

set and the speed change lever must be in neutral position before the cranking can take place, and in the event of a back fire from the engine the crank will immediately disengage from the engine shaft. The use of the device is intended also to prevent injury to a person while cranking an explosive engine.

Household Utilities.

COOKING UTENSIL.—G. W. BLODGETT, 387 E. Washington St., Portland, Ore. The inventor's purpose is to provide a cover for the vessel which will prevent cooking without liquid in the vessel, and also condense the vapors formed during cooking and return the same to the vessel. This is obtained by providing a cover formed of a series of superposed members having a large condensing surface.

WASTE AND VENT SYSTEM.—C. S. C. ROCK, 204 W. 140th St., New York, N. Y. The object here is to provide a system having a plumber's fitting designed to connect the soil pipe with the vent pipe and adapted to connect with bath tubs, sinks, water closets and other fixtures to be drained and vented, the arrangements being such that the plumber can readily assemble the parts and make the desired connections, and that proper drainage and venting is insured.

COOKER.—R. W. RYON, 304 3rd St., S. E., Washington, D. C. An object in this case is to provide a device in which the cooking of such articles as sausages may be conducted while at the same time the heating of other articles, such as rolls, may be accomplished with means for permitting the flavor or essence of the sausages to be absorbed by the rolls.

COMBINATION SUPPLY AND WASTE FIXTURE FOR LAVATORIES.—W. A. SPEAKMAN, care of Speakman Supply and Pipe Co., Wilmington, Del. Among the objects of this invention is to provide a fixture of unusually simple and neat design whereby the manipulation of the fixture is facilitated and the device rendered more reliable than previous ones. Further, to provide a water supply fixture for lavatories which is adapted to be used in connection with standard basins without alteration thereof.

DISPENSING BOWL.—S. A. ADDIS, 944 Tiffany St., Bronx, N. Y., N. Y. This invention relates particularly to an improved bowl for dispensing sugar and other similar material, and has for an object to provide an improved structure which will allow the dispensing of measured quantities of sugar, and will prevent any wasting thereof.

GAS RANGE BURNER.—E. S. ALLEN, 517 E. 134th St., New York, N. Y. The improvement has reference to gas range burners, and the invention comprehends a burner provided with a valve, said valve being controllable by the position of a grid or spider associated with the burner for the purpose of supporting pans or other articles to be heated.

Machines and Mechanical Devices.

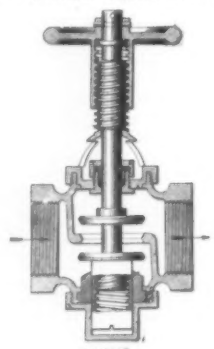
THREAD CUTTING MACHINE.—J. A. DOWD, P. O. Box 488, Fall River, Mass. This invention refers to improvements in machines for cutting threads upon pipes, bars and the like, and for severing the pipes and bars at desired lengths. The purpose is to provide a structure which will continually operate for threading a pipe, bar or the like, and intermittently severing the pipe or bar into lengths.

SHAPING ROLLS FOR HORSESHOE BARS.—L. T. FAGE, Box 104, Wareham, Mass. The invention provides means for mechanically creasing and partially punching the bars from which horseshoes are subsequently made; prevents the creeping or misregistering of the rolls with the bars and shoe-forming sections thereof; and reduces the friction offered by the bars to the rolls when passing therethrough.

MIXING AND SIFTING MACHINE.—S. L. HARWOOD, Dublin, Ga. This apparatus is for use in mixing and sifting fertilizing materials, and the machine will deliver a mixture which is very uniform, instead of discharging the fine ingredients of the mixture first and depositing the finer part of the mixture in the bottom of the sacks which receive it, an objection met heretofore in devices of this sort.

MARINE SAFETY DEVICE.—M. BOUCHET, 22 Rue Alphonse de Neuville, Paris, France. The inventor provides for increasing the buoyancy of the vessel at certain critical times when danger may accrue from undue pressure of water outside of the vessel, thus tending to crush the vessel inwardly, or from excessive air pressure inside of the vessel, having a tendency to disrupt the vessel or some portion thereof.

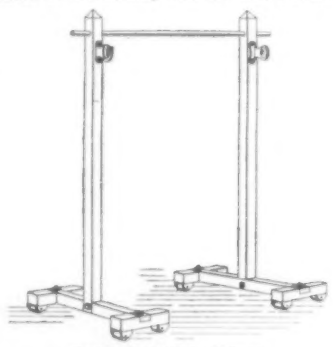
VALVE.—A. E. CRUM, Mobile, Ala. This invention relates more particularly to a structure comprising a casing which permits the use of parts whereby a double-acting or a single-acting valve construction is provided. One of the principal objects here is to pro-



VALVE.

vide a valve which, when used as a double-acting valve, comprises co-operating parts, whereby the lower and upper valves may be accurately adjusted on their seats when the valve is being assembled or in taking up the slack from near.

WINDOW SHADE TESTER.—J. ISAACS, Hobart, Okla. This invention has for its object the provision of a device by means of which dealers in furniture and other dealers selling shades or blinds, may test the said shades or

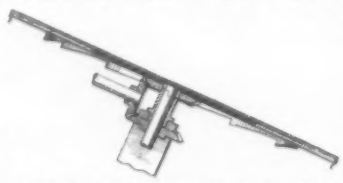


WINDOW SHADE TESTER.

blinds in the presence of the buyer, to demonstrate that the individual shades or blinds are in proper working condition, and wherein the supporting mechanism for the shades may be adjusted to any size of shade.

CLOTH WORKING MACHINE.—G. H. WIEMANN, 262 N. 6th St., Brooklyn, N. Y. This machine winds or bolts quantities of cloth piled up in folds, each layer being separated from the layer above and below the same by sheets of paper or similar material. The sheets of paper are continuously removed by the machine at the same time that the operation of winding the cloth is in progress.

INKING DISK FOR PRINTING PRESSES.—F. J. ANTELOTTI, Norfolk, Va. This invention provides an auxiliary disk which may be used in connection with printing presses having inking mechanism consisting of a plurality of concentric disks with means for oscillating or rotating the disks in opposite directions and thereby more evenly distributing the ink. The auxiliary inking disk may be attached to the outer of the concentric inking disks and may



INKING DISK FOR PRINTING PRESSES.

be spaced from the inner of said disks, thereby permitting the free movement of the inner disk. A cover for the inner and outer inking disks serves as an inking disk itself, and when removed permits the inking to be done by the inner and outer concentric disks which form part of the normal structure of a machine.

LOOM SHUTTLE.—W. H. WILSON, 7 Bedford St., New Bedford, Mass. This shuttle is arranged to prevent the slack of the thread and consequent breaking thereof, and to prevent the thread from accidentally passing out of the eye at the end of the shuttle at the time the shuttle advances from the shuttle box toward the cloth, as at this time the thread is liable to curl up and break on further advance of the shuttle.

STRAP AND TAB FORMING MACHINE.—F. METZENBACHER, care of W. H. Rich & Son, 768 Pacific Street, Brooklyn, N. Y. This machine is for use in the manufacture of umbrellas and other like purposes, and has reference more particularly to a machine of this class which comprise a strip forming mechanism, a cutter for severing the formed strip into lengths to produce straps or tabs, and means for simultaneously operating the strip forming mechanism and the cutter.

ALARM CLOCK ATTACHMENT.—R. P. PACKARD, 3717 6th Ave., Tacoma, Wash. The device is for use in connection with ordinary alarm clocks, and the aim thereof is to cause a lamp to be lighted when the alarm is rung. It comprises connections which are controlled by the position of the parts of the alarm mechanism and are so arranged further that the lamp can be caused to remain lighted so that the same can be kept in use after the alarm has ceased.

SHUTTLE MACHINE EMBROIDERY FRAME.—H. HOCHREUTENER, 706 Highpoint Ave., West Hoboken, N. J. This invention relates to improvements in frames for embroidery machines and to what are called section frames, and has for an object to provide improved structures in which no waste spaces are provided. Means provide for the ready removal at times of the articles to be embroidered.

Prime Movers and Their Accessories.

INTERNAL COMBUSTION ENGINE.—N. H. SCHICKEL, 50 Garden St., Stamford, Conn. The object of the invention is to provide a feeding mechanism for internal combustion engines, such that the fluid to be fed will be displaced from the pumping chamber and transferred to the working cylinder in a substantially uncompressed state while the inlet port is open.

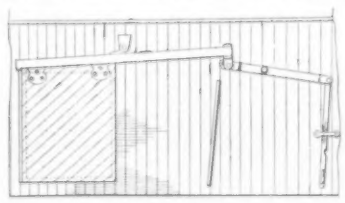
FLUID OPERATED ROTARY PRIME MOVER.—G. H. ALEXANDER and W. G. ROBINSON, respectively at Doe St., and 5 Elm Cottages, Falconer Road, Birmingham, England. This invention relates to such fluid operated rotary prime movers as rotary internal combustion, steam, water and air engines, of the type in which a pair of cylinders and pistons is arranged parallel with each of a pair of axes mounted at an angle to each other, and the pistons are connected by suitable links with the members of a Hookes' or universal joint situated at the junction of the axes.

Railways and Their Accessories.

CONCRETE RAILWAY TIE.—R. T. BAGBY, Whitney, N. C. The object in this case is to provide a strong, inexpensive and stable tie which has large bearing areas in the road ballast for each of the rails, and the center of which area is substantially in alinement with the axis of the rail.

GATE OPERATING MECHANISM.—J. E. C. JACOBSEN, 29 Fourth Ave., Nyack, N. Y., and C. A. V. J. SEGERSTEN, Nyack, N. Y. This invention comprehends mechanism whereby a train in approaching a predetermined part of a track provided with gates will cause the gate to close automatically, will actuate lamps serving as alarms, and will retain the gates closed and the alarm active so long as the train is present, but when the train departs, the gates are automatically opened and the alarm rendered inactive.

DOOR OPERATING MECHANISM.—W. E. HARRIS, care of Scott Mfg. Co., Houston, Tex. The object here is to provide mechanism especially adapted for freight car doors, wherein

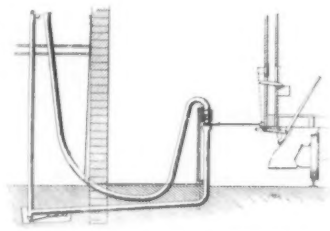


DOOR OPERATING MECHANISM.

a pivotally mounted track is provided for supporting the door, together with mechanism for swinging the track, in order to utilize the weight of the door in opening and closing the same.

RAIL FASTENING.—L. FAUQUÉ, 52 Rue de Louviers, St.-Germain-en-Laye (Seine-et-Oise), France. This invention insures the fixation of the rail by means of a device offering a resistance to the pulling stress always equal to the breaking strain of the metal of which it is constituted, allowing without any screw threading, a much more secure clamping than that of the screw spike and opposing any sinking of the rail on its supports, all these conditions being necessary for insuring the fixation of the rails of the wooden sleepers made of any species of wood.

MEANS FOR INTERCHANGE OF MESSAGES BETWEEN A STATION AND A MOVING CAR.—O. H. SMITH and J. L. SMITH, Stratford, Penn. Address the former. This



MECHANISM FOR INTERCHANGE OF MESSAGES.

invention relates to mechanism of the character set forth in a previous patent, No. 1,042,983, issued to these inventors. It provides a system of tubing leading from a railway station or other building in the proximity to a railway track, such tubing being adapted to deliver carriers to and from a car, such carriers being secured and deposited by the car as it moves along.

Pertaining to Vehicles.

SPRING HUB.—W. H. LASSWELL, care Savoy Hotel, San Antonio, Tex. This hub is for use in automobiles and other vehicles, wherein yielding mechanism is provided within the hub, between the spindle and the wheel, for cushioning the vehicle against jar and jolting, and wherein yielding mechanism is concealed from view and protected from external injury and the entrance of dust and the like.

SHOCK ABSORBER.—J. H. NEDER, 2437 Center St., Baker City, Ore. This absorber protects the arched springs of a vehicle from breakage due to sudden rebound of the springs as the vehicle passes over an obstruction or rough ground. The absorber is in the form of a helical spring readily attachable to the arched springs of the vehicle, which shall be noiseless.

RESILIENT TIRE.—B. E. LEAS, care of Nelson Bros., Luverne, Minn. In this wheel the tread is movable relatively to the felly through the medium of ball bearings and springs, such parts being permanently inclosed, whereby they are kept free from entrance of dust and foreign matter. Provision is made for maintaining the bearings in a constant state of lubrication.

TIRE SPREADING DEVICE.—J. O. STEWART, 1201 First Ave., Spokane, Wash. In the present patent the invention refers to improvements in tire spreading devices, and has for an object the provision of an improved structure for spreading a clincher tire structure so as to permit ready inspection of the interior thereof.

DOOR FOR AUTOMOBILES.—W. G. MINER, Sayler Park Station, Cincinnati, Ohio. Doors of automobiles are ordinarily arranged to swing outward. The inventor has devised an improvement by which doors are adapted to slide horizontally in guideways and pockets provided in the body of the vehicle, and he has provided such doors with spring attachments as a means or aid for closing them.

WHIP HOLDER.—F. F. PROVAN, Marion, N. D. The invention comprises means for engaging the doubletree of the leading team or other fixed support, and a holder proper for the whip hinged to the said means for swinging movement, together with means operable from a distance for swinging the holder, and other means for returning the holder to upright position, the holder having means for clamping a whip.

Designs.

DESIGN FOR A GOBLET.—E. W. NEWTON, Chicago, Ill. This ornamental design for a goblet shows an article of rather tall form with a slim stem and plain base, the side view presenting a gracefully waved outline.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12941) A. W. F. asks: Will you be kind enough to tell how to make a selenium cell, or, at least, what materials are used as contacts, and how? I have a piece of crystal selenium. Do you think that I could make a cell with this piece sensitive enough to close a 150-ohm relay when the rays of an ordinary tungsten lamp are allowed to fall upon it? A. We would advise you that you cannot use a lump of selenium as a selenium cell. It is not sensitive to light. The selenium must be treated to render it sensitive to light by heating for a long time. The cell is made by coating wires with the selenium so that the current may flow from one wire to the other through the sensitive coating. The whole process is described in the SCIENTIFIC AMERICAN and the SUPPLEMENT in a number of papers. We name SUPPLEMENT Nos. 1430, 1881, 1882, 1883, 1897, 1719, 1912; and the SCIENTIFIC AMERICAN, Vol. 100, No. 11, and Vol. 107, No. 21. We will send the nine papers for 90 cents. With these you will have full instructions how to proceed as well as full information upon the general subject of a selenium cell.

(12942) L. J. S. asks: 1. We have recently inquired if it is possible for you to inform us why vacuum bottles are covered inside with nitrate of silver. Does this process increase the efficiency of the bottle? Also, please inform us if there is any literature published on this subject? A. The vacuum bottles about which you inquire are coated with metallic silver and not with nitrate of silver. This last is a white crystalline substance which is readily soluble in water and could not be made to coat glass. The metallic silver is deposited upon the outer side of the inner bottle and the inner of the outer bottle so that there are two coatings of silver. The object is to prevent the passage of heat. A polished surface is a good reflector and poor absorber of heat. Hence the outer surface of the bottle reflects most of the heat from the outside, and the second surface takes care of the rest. These bottles are the best known to preserve a liquid at a given temperature. Liquid air has been kept for a longer time in them than in any other way. There is no special literature upon the subject. 2. Kindly inform us if you know of any late literature published on the subject of water purification by means of ozone. A. You will find valuable papers upon ozone in the SCIENTIFIC AMERICAN, Vol. 107, No. 7, and Vol. 109, No. 1; also in the SUPPLEMENT, Nos. 1832, 1895 and 1978, price ten cents each.

(12943) F. D. D. asks: This city is 5 hours, 42 minutes 40 seconds slow of Greenwich, therefore when it is noon at Greenwich it is 6 hours, 17 minutes, 20 seconds A. M. here, January 21st the sidereal time of mean noon at Greenwich is 20 hours, 0 minutes, 1.85 seconds. If at just 6 hours, 17 minutes, 20 seconds here I set my sidereal clock at 20 hours, 0 minutes, 1.35 seconds, will not that be the correct sidereal time at that moment here? It seems to me that it is correct, and a very easy way to set a sidereal clock, provided one is sure of his longitude. A. If the difference of longitude is accurately known between your place and Greenwich, and you have the sidereal time of mean noon at Greenwich, you can set a sidereal clock to the sidereal time of your place as closely as the clock will allow. You could not set the clock to the hundredth of a second. No clock can be set with that degree of accuracy.

(12944) A. J. R. asks: 1. Is it possible for ice to vary in temperature or density? A. Ice acts toward heat just like any other solid. Raise it to its melting point and it turns to water, just as lead and tin melt when they are raised to their melting points. Cool it and it becomes colder just as any other stone or mineral will do. If it is cooled it contracts and becomes denser, just as a piece of copper will do. A piece of ice lying in the open air when the thermometer stands at zero will itself be at zero in temperature. 2. Would there be any difference in the temperature of two cakes of ice brought to New York during weather never above 32 deg., one cake cut in the Hudson Bay country, the other in the Hudson River? Would one cake melt faster than the other if the weather got above 32 deg.? A. If two cakes of ice were brought to New York from any great distance, when they reached this city they would both become of the temperature which the thermometer here indicates, the temperature of the air in New York. If one of these cakes had fewer air bubbles in it than the other, that cake might melt slower than the one which contained more air, but the difference would be due to the ice, not to the temperature. 3. Would a thermometer placed in the center of an iceberg indicate a greater degree of cold than if placed near the surface? A. Ice in contact with air or water which is warmer than 32 deg. Fahr. will be at 32 deg., the melting point of ice. It cannot be made hotter than 32 degrees without turning to water. So long as it is ice it is not hotter than 32 deg. Fahr., no matter what it is in contact with. An iceberg floating in water will be at 32 degrees if the water is not colder than 32 degrees, since the ice is fresh and not salt. 4. Assuming a deep river or lake to be frozen to a depth of 32 inches, with the weather at zero, would the ice have a gradually higher temperature of one degree to the inch from 0 degree at the surface to 32 degrees at the bottom? A. Ice 32 inches thick, when the air on the top is at 0 degree and the water below is at 32 degrees, will change its temperature from top to bottom about 1 degree per inch, as you state. 5. If the weather remained at exactly 32 degrees all winter, would the ice in a pond increase in thickness from day to day, or would only a thin coat of ice form on the surface? A. Ice could not become very thick if the air above did not become colder than 32 degrees at any time. 6. Can a cake of ice—without melting—lower the temperature of an article placed on top of or adjacent to it? A. Ice cannot cool anything without melting, excepting the ice is colder than 32 degrees and the article in contact with the ice is already as cold as 32 degrees. Ice at 32 degrees in contact with an article which is above 32 degrees cannot cool that article without itself melting. An ice box in Summer is not itself cooled by the ice unless the ice melts.

(12945) O. W. F. asks: I would like to know why telephone wires do not sing alike when the wind blows and when it does not. Sometimes they make quite a great deal of racket when the wind is not blowing, and again they do not make any. A. A wire strung through the air sings, or gives a musical sound, when the wind blows over it, and the friction of the air sets the wire into vibration in the same manner in which a violin string is vibrated by the friction of the bow. It is not necessary that the wind should be blowing hard for this effect to be produced, indeed, the tones are softer when a gentle breeze draws over the wires. Nor is it necessary that the sound should be produced at the place where it is heard. It may be quite a distance away where the breeze is rubbing over the wires, since sound is carried with a high velocity over metals. We think this sound is always due to the friction of the air across the wires. The action is like that of the Æolian harp.

(12946) H. D. asks: I wish to know the exact effect of centrifugal force in connection with the ocean tides which rise on the side of the earth opposite from the moon. I find no reference to this subject in popular astronomics or in the textbooks I have seen. As the center of gravity between earth and moon lies some 3,000 miles below the earth's surface, it follows that about 5,000 miles is the radius of a circle described by an imaginary point on the earth's surface every lunar month. It also follows that every part of the sea is more or less affected by the centrifugal force resulting from this slow revolution and affected by it every day. Is not the opposite tide to a large extent the result of this force? What books treat of the matter? A. We have never seen any calculations of the centrifugal force developed in the rotation of the side of the earth opposite the moon and its effect upon the waters of the ocean in the tide on that side of the earth. It can be but slight. The tide on the side opposite the moon is due to the fact that the attraction of the moon on the solid earth is greater than the attraction upon the water on that side of the earth. The center of gravity of the earth is about 60 radii of the earth from the moon, while the water of the remote side is 61 radii distant from the moon. The attraction upon the solid earth, as compared with that upon the water, is therefore $\left(\frac{61}{60}\right)^2$ which is 1.033 +. Thus the attraction upon the earth is about 3.3 per cent less than it is upon the remote water. A similar calculation for the side of the earth toward the moon gives a result that the tide-raising force on the side toward the moon is about 3.4 per cent of gravity. Centrifugal force plays its part in the formation of the tides, but it is not the larger factor in the problem.

(12947) C. S. C. asks: Do you know of any metal or substance of any kind that the lines, magnetic lines, from a permanent magnet will not penetrate? Some material, if a permanent magnet is placed under it and iron filings above, that the filings will not be attracted. A. There is no material known through which lines of magnetic force will not pass. The only way in which a magnet can be screened is to place it in an iron box. The iron affords a much easier path for the magnetic lines so that they do not emerge into the air on the inside. This forms what is called a magnetic screen.

(12948) R. A. D. asks: I note your reply to Query 12893 on January 3d, 1914. May I ask whether there is no more modern theory of the behavior of gaseous molecules than that of their being perfectly elastic bodies which collide and rebound without loss of energy by virtue of this property of perfect elasticity? If the pressure that a gas exerts upon the walls of a containing vessel is due to the velocity of the mass of the molecule, as in the case of a sensible missile, why is not the velocity of the molecule lessened with each impact, and consequently the pressure, even though the temperature remains constant? Briefly, is not the hypothesis of perfect elasticity merely a convenient cover for our ignorance of the specific nature of the phenomena in question? Is there accessible any coherent speculation on the subject? A. The well-nigh universal acceptance of the theory of perfect elasticity of gas molecules is the basis for our statement in Query 12893, which you question. Since your letter was received we have gone through the latest works by the best authors on this subject and find our statement in varying terms in them all. Gas pressure is regarded as simply the beating of the molecules against the walls of the vessel and each other. One states it that the molecules rebound with "undiminished velocity," which is just the same as saying that they possess perfect elasticity. Another says, "This theory is held because it enables all the laws of gases to be readily explained." There is no disagreement among physicists on this point. So we are not able to refer you to any "coherent speculation" about the matter.

(12949) O. O. B. asks: In Millikan & Gale's "Physics" there is the following experiment under the topic "Heat of Fusion": In a mixture of salt water pour snow or cracked ice and stir vigorously until the temperature reaches a point 10 or 12 degrees below zero Cent. Then into this place a test tube containing pure water and a thermometer. Note that the temperature of the water in the test tube will fall as much as 10 or 12 degrees below zero Cent. and not freeze, but as soon as you drop into the test tube a small piece of ice or stir the thermometer, the temperature will fall to zero Cent. and will remain there until the water is all frozen. Please explain why the water in the test tube does not begin to freeze as soon as it gets to zero Cent. Is it because water will not freeze at zero Cent. provided it is kept perfectly still? A. The experiment which you describe is one which illustrates "undercooling." A liquid which has a definite freezing point can be cooled several degrees below that point without freezing if it is kept still so that there is no jarring or motion of the liquid, or if it is covered with a layer of oil. But if it be jarred or a shock be given to it by dropping a crystal of the same substance into the liquid, it will crystallize at once. Sodium sulphate dissolved by heat is often used for the experiment, although water will answer very well. The undercooled liquid is in unstable equilibrium, and the molecular attractions are equal in all directions, but when the liquid is stirred the equilibrium is upset, and the molecules then jump into their places in the solid form which their temperature requires.

(12950) J. W. McC. asks: I am anxious to get in touch with some schools that have divided, or rather segregated, the boys and girls in the physics work. We are doing the work on this line this year, but have not been able to find a suitable text for the girls. This is what I am after. Any information will be appreciated. A. We do not know any schools in which the girls are taught physics in classes separated from the boys. Physics is usually taught as a branch of mathematics in high schools and most colleges, and the subject is divested of most of its interest for young people for this reason. A textbook based upon the experiment and not upon the formula is much to be desired. One appeared this year which is very attractively gotten up by Millikan & Gale, which we send for $1.40 postpaid. It is called "A First Course in Physics," and is almost wholly descriptive. No similar college textbook has appeared.

(12951) T. A. B. asks: I had a question asked me as to what was in a thermometer. I said that mercury and alcohol were used, but some said that quinine and some other liquid were in them. I would like to have you tell me what is used in them. A. The liquids used for filling thermometers are mercury and alcohol. Sometimes the alcohol is colored red with a dye. Quinine is not a liquid, but is dissolved in water, and water cannot be used for a thermometer in any place where it would freeze, for the reason that it expands when it freezes and bursts the vessel. Alcohol does not freeze till it is cooled 200 deg. Fahr. below zero, and the lowest temperature on the earth is not 100 degrees below zero. Hence alcohol is used in all places where the temperature falls below —40 degrees, at which point mercury freezes. Mercury may freeze in a thermometer without breaking it, since mercury contracts on freezing. But it will not indicate temperature correctly after freezing because it contracts differently in the solid from what it does in the liquid condition.

(12952) If the correspondent from Fairmont, W. Va., will give us his name, we will be glad to give him the information asked for. It is impossible for us to reply to unsigned communications.

(12953) If H. T. will send his name and address we will gladly answer his question. But no attention can be paid to unsigned queries. In this case the answer would be by mail, since the answer has no interest excepting for himself.

(12954) J. T. P. asks: Being a reader of your paper, and noting that you maintain a column in which you answer questions pertaining to scientific matters, I should like to know if you can give me a formula that will enable me to soften printer's ink. What I wish this information for is, to transfer printed pictures to paper, cardboard, etc. Perhaps you can tell me some method by which I can do this work. My biggest trouble seems to be in finding a solvent that will not destroy the colors in the print. I would also like to get a formula for sensitizing paper, etc., such as is used in photography. I have the blueprint formula, but am in need of something that will give me a black and white, or a brown and white print. I understand that you publish a book of formulas, etc. I will be pleased to learn the price, etc. I consider Notes and Queries worth the price of SCIENTIFIC AMERICAN alone. I have received some valuable hints therein. A. A method of transferring newspaper pictures is given in our "Scientific American Cyclopedia of Formulas," price $5, as follows: In 1 pint of hot water dissolve 1½ drams of common yellow soap, and when nearly cold add 3¼ fluid ounces of spirits of turpentine. Shake the mixture thoroughly. Apply this fluid liberally to the surface of the print with a sponge or soft brush, being careful not to smear the ink, which soon becomes soft. Then dampen well the plain paper upon which the transfer is to be made, and apply it smoothly to the print with moderate pressure for about one minute. On separating them a reversed copy of the print will be found upon the paper. The Cyclopedia contains many other processes for transferring. Information on the subject will also be found in our SUPPLEMENT, Nos. 1122, 1141 and 1094; price 10 cents each, mailed.

(12955) F. Z. asks: Wanting to use old negatives, is there some cold-water formula for removing the film from the glass that is non-injurious to the hands? A. There is no efficient cold-water method for dissolving gelatine film from old negatives. Boiling them in water will dissolve the film, but the best way to get it off is by soaking in strong nitric acid. This can be done without injury to the hands. Handle the plates with thin slips of wood, sharpened to an edge, which nitric acid does not readily affect. The glasses can be taken out of the acid with these pieces of wood and dropped into water to wash off the acid. The next wash should be of potash, and then a final bath in hot water will complete the cleaning. For the wooden slips we use pieces of cigar boxes.

(12956) F. A. L. asks: During a discussion of the relative merits of gas and electricity for heating, a very heated argument arose as to the scientific reason, or I might say the theoretical reason, of the non-luminosity of a Bunsen flame. It was agreed to submit the question to you for explanation, as all of us are readers of your valuable paper. Your decision will settle a much-vexed question. A. The low luminosity of a Bunsen flame is due to the more complete combustion of the gas in the flame by the oxygen of the air which is mixed with the gas before it comes to the flame and is ignited. In an ordinary flat flame the air comes into contact with the gas at the base of the flame and there you will see a blue or nearly colorless flame. Here the heat is sufficiently high to reduce the gas to solid carbon particles and to heat these so that they become luminous. The oxygen of the air in contact with the flame above now burns the solid carbon, and changes it to carbon dioxide, after which the gas diffuses into the surrounding air. The temperature of a Bunsen flame is higher than of a luminous flame, since the combustion is more perfect and the heat is confined to a smaller area. The temperature of a luminous flame is that of white heat of the solid carbon particles. It is given somewhat differently by different authorities, but it may be safely taken at 2,000 deg. Fahr., or perhaps at 2,200 deg. Fahr. The temperature of the Bunsen flame may be taken at about 2,900 deg. Fahr. This is the figure of Prof. Vivian Lewes, as quoted in Ganot.

(12957) B. asks: 1. Can you tell me whether the relation between heat, light and sound is such that if a metal bar were set in vibration and the vibration frequencies gradually increased, sound, heat and light would be produced in turn? A. The mode of vibration in sound is that the material which is in vibration moves backward and forward in the same direction as the wave is moving. The motion of the vibrations in heat and light are across the direction in which the wave is moving. A sound wave cannot affect the eye nor can heat and light waves affect the ear. 2. Are not light waves shorter than heat waves, and in heat are the waves shorter in higher temperatures? A. Heat and light are the same in kind, only differing in degree. In the light spectrum, the longest waves which are visible to the eye are three hundred ten-millionths of an inch long, and the shortest are one hundred and fifty-six ten-millionths of an inch long. Heat waves extend through the greater part of the light spectrum, and far below it, thus having a greater range. Within the range which the eye can perceive, if a train of waves enters the eye we see by means of it; but if it struck the skin we should feel heat and not light. The same waves affect the person differently according to the nerve they impinge upon. If they strike the optic nerve they are transformed into light, if they strike a nerve which can feel heat they are perceived as heat. Light waves are longest in the red of the spectrum and shortest in the violet. Heat waves extend below the red for a long distance, increasing in length downward below the red heat. The higher temperatures have the shorter waves. 3. Mathematically there would be no vacuum created in a Torricellian tube if the tube were 50 centimeters in length. Is that correct? A. The vacuum in a Torricellian tube is formed when the tube is so long that the pressure of the air is not able to support the mercury to the top of it. At the sea level and in good weather, the mercury will be held up to 30 inches, or 76 centimeters. If the tube is shorter than that the mercury will be held up to the top; if longer, the mercury will not fill the tube and the space above the mercury is called a Torricellian vacuum. It contains vapor of mercury.

NEW BOOKS, ETC.

WAR TIME IN MANILA. By Rear-Admiral Bradley A. Fiske, U.S.N., of the U.S.S. "Petrel" and "Monadnock" during the War. 275 pp.; numerous half-tone illustrations. Boston: Richard G. Badger, The Gorham Press.

It is many years since Dewey sailed into Manila Bay and fought the memorable action with the Spanish fleet; but it is not so long ago that the more intimate incidents of that action and of the events succeeding as told by a personal eyewitness fail to have a fascinating interest for the reader. Much has been written about the naval and military campaign in the Philippine Islands; but we doubt if any work has appeared which carries such a personal and intimate touch as the simply and very graphically written account contained in this volume.

Many people have wondered how the fighting man feels in the moments preceding his entry into battle, and this volume gives us, here and there, an illuminating insight to the psychological side of this interesting question, as note the following, describing the night hours immediately preceding the battle of Manila Bay:

"I found the wardroom absolutely dark. Then I felt my way to my own room and lay down on my bunk. The deck above my head was distant about two feet, and I thought how very flat I would be squashed out against that deck if a torpedo exploded under the ship." Fiske's position during the engagement was probably one of the best points of vantage from which to view the battle with Admiral Montojo's little fleet of gunboats. Says he: "There was not even a conning tower on the 'Petrel,' so I had rigged up a platform on the foremast about forty-five feet up, where I could sit with my stadimeter above smoke and measure the range of the enemy and inform the captain of whatever important incidents or movements my clearer view might enable me to see." Says the writer: "About the decks of the 'Petrel' things were entirely different from what I had expected. I had seen many pictures of battles and expected great excitement. I did not see any excitement whatever. The men seemed to me to be laboring under an intense strain and to be keyed up to the highest pitch, but to be quiet, and under complete self-control, and to be doing the work of handling the guns and ammunition with that mechanical precision which is the result we all hope to get from drill." Admiral Fiske criticises the Spaniards for not putting their fleet under the batteries of Manila, where four powerful modern 9.2-inch guns were mounted; guns which if properly handled, could have sunk the whole of the American fleet. "Any one of those guns would have sunk our vessel or disabled the other ships." The work deals in the most interesting and illuminating way not merely with the sea-fight itself but with the operations, naval and military, which followed Dewey's victory. Anyone who wishes to get an intimate view of naval life, as seen from the standpoint of an unusually intelligent and observant naval officer who has the gift of looking below the surface of things and analyzing what he sees with a philosophical mind, will do well to purchase this most interesting work.

MACHINERY'S HANDBOOK. For Machine Shop and Draughting Room. A Reference Book on Machine Design and Shop Practice for the Mechanical Engineer, Toolmaker and Machinist. New York: The Industrial Press, 1914. 12mo.; 1400 pp.; illustrated. Price, $5.

Machinery has put out a reference book that is good to the eye and helpful to the hand. It embodies the best of a twenty years' accumulation of material, with gleanings of important data from hundreds of sources. The work collects and systematizes the established principles and practice in the design, construction and operation of machinery. There are tables—mathematical, logarithmic and trigonometrical; data dealing with strength of materials, with gages, with keys and keyways, with shafting, and with gearing; formulæ for springs, block brakes, rope drums and riveted joints. This is but mere random mention. It would be hard indeed to find any essential phase of machine design or construction that has been overlooked or slighted. The pages are lavish of diagram and clear as to meaning. Among operations may be cited grinding, polishing, broaching, testing for hardness, die-casting, forging, welding and etching. This list will convey some idea of the versatility of treatment. The primary principles of geometry, and of mechanics, are concisely set forth; the properties of air, water and heat are considered; there is a digest of the patent regulations, and an index which is the open sesame to the treasure of the volume. The work easily takes the place of many smaller and less authoritative books that cumber the shelf of the mechanical engineer, the draughtsman and the machinist.

ARTIFICIAL PARTHENOGENESIS AND FERTILIZATION. By Jacques Loeb, Member of the Rockefeller Institute for Medical Research. Originally translated from the German by W. O. Rodman King, B.A. Chicago: The University of Chicago Press, 1913. 8vo.; 312 pp. Price, $2.50 net. Postage, 18 cents.

This is an enlargement of the work that in 1909 set the world talking—a description of the experiments that led the press to announce that the artificial production of life was an accomplished fact. The actual extent of the achievement is, of course, the artificial fertilization of the egg, dispensing with the assistance of the spermatozoon; and in using these physico-chemical agencies the result is limited to fertilization and maturation, the hereditary features usually conveyed by the male cell naturally being absent. This, however, is glory enough for the time being. It is but the absorbing preface to what is practically a new science. Loeb's first two chapters set forth the present status of this science in language readily understood by any educated person. The behavior of the egg under the chemical stimulant is closely observed, and deductions as to its changes under the influence of the spermatozoon are interestingly drawn. A suggestion: laymen are to-day closely following the development even of abstruse and specialized science; subjects that were yesterday closed to popular discussion are to-day topics of general conversation. Why do not scientists more generally include in their works a glossary of the terms used? This would add greatly to the satisfaction of the general reader, promote the sale of such works, and forward the cause of education.

HARPER'S BEGINNING ELECTRICITY. By Don Cameron Shafer. New York: Harper & Brothers, 1913. 8vo.; 275 pp.; fully illustrated. Price, $1 net.

HARPER'S WIRELESS BOOK. How to Use Wireless Electricity in Telegraphing, Telephoning, and the Transmission of Power. By A. Hyatt Verrill. New York: Harper & Brothers, 1913. 8vo.; 185 pp.; fully illustrated. Price, $1 net.

These two books, uniform in size, address themselves to the young student. The first forms an introduction to the general subject of electricity. Written for "the real beginner," the text shows extreme care in the selection and presentation of the various phases of a complex subject. What we know about electricity is sketched in the first chapter; from a talk on the behavior of electrical energy we pass to simple experiments in static electricity, and to galvanic action. Batteries, the electric circuit, magnetism, and their application in modern devices are but a few of the things explained. The second volume is a brightly written manual of wireless. The principles, operation, and construction of wireless transmission are lucidly set forth with the aid of lavish illustration. The chapter on the establishment of a station deals with site, construction of aerials, insulating, and ground connections. The student is wisely taught to make his own instruments—for in no other way is such a grasp of essentials obtained as by making a thing throughout.

SUSPENSION BRIDGES AND CANTILEVERS. Their Economic Proportions and Limiting Spans. By D. B. Steinman, C.E., Ph.D. New York: D. Van Nostrand Company, 1913. 16mo.; 185 pp. Price, 50 cents.

The entrance of this little work into a second edition has given opportunity for its revision. The analytical studies of the relative merits of suspension and cantilever types remain the same, but there are modifications in nomenclature and definitions which allow the distinctions between theoretical and practical limits of span to be more closely drawn. All alterations are in the interests of precision; the bibliographies have been extended; and references to articles appearing since the publication of the first edition have been added. Four folding plates illustrate the described designs.

THE "WELLCOME" PHOTOGRAPHIC EXPOSURE RECORD AND DIARY. 1914. New York: Burroughs, Wellcome & Co. Price, 50 cents.

The Record is a neat little snap-flap pocket-book with processes and tables; a number of blank pages are ruled for recording details of negative exposures, with space for an index. Diary and memoranda pages follow. A unique feature of the book is the circular sliding scale affixed to the inside back cover, which gives the correct exposure in seconds or fractions of a second. The issue of a special United States edition is a point that will appeal to American photographers.

SOLVENTS, OILS, GUMS, WAXES AND ALLIED SUBSTANCES. By Frederic S. Hyde, Ph.B. New York: D. Van Nostrand Company, 1913. 12mo.; 176 pp. Price, $2 net.

The factory chemist will find in this condensed reference work descriptions of the organic products of commerce, with their chemical make-up, a hint as to the process of obtaining them, and details of their appearance, qualities, and chief uses. The products are grouped under general heads such as terpene bodies, soaps, fatty acids, carbohydrates, etc. Any difficulty in finding a required substance, due to ignorance of the classification under which it comes, is obviated by a full index.

THE BRITISH JOURNAL PHOTOGRAPHIC ALMANAC AND PHOTOGRAPHER'S DAILY COMPANION. 1914. Edited by George E. Brown, F.I.C. Fifty-third issue. New York: George Murphy, Inc. Price, paper, 50 cents; cloth, $1.

A triumph of compact corpulence, the annual comes to us this year with its usual quota of directories, formulæ, and papers. Since the advertisements are responsible for more than two thirds of the volume's bulk, we may be pardoned for mentioning them first. They are not only advertisements—they are divertisements—good, bad, and indifferent, but mostly good. Their photographic reproductions and the wealth of old and new apparatus they offer will hold the camera operator's attention as much as the text proper. The latter, in addition to the almanac, tables, and processes, numbers among many new features a glossary of photographical terms, with foreign equivalents; and reproductions of incorrectly exposed and developed negatives, which point their moral more effectively than pages of dry warning. The progress of the past year is summarized, and helpful hints and articles abound.

HANDBOOK ON SANITATION. A Manual of Theoretical and Practical Sanitation. By George M. Price, M.D. New York: John Wiley & Sons, Inc., 1913. 12mo.; 353 pp.; 25 illustrations. Price, $1.50 net.

This handbook, first published twelve years ago, is in its rewritten form to be unqualifiedly commended to health-inspectors and physicians. It is used as a school and college text-book, and might be very profitably studied by the general public. It covers soil and sites, air, ventilation, heating, water supply, sewage disposal, and plumbing. These constitute the material of the first part. The second is devoted to sanitary practice, and deals with the problems of housing, of trades and occupations, and of disinfection. The third part relates to sanitary inspection as a profession and gives important information on civil service examinations, with many useful calculations and tables. The style is condensed, but practical.

THE WONDERS OF WIRELESS TELEGRAPHY. Explained in Simple Terms for the Non-Technical Reader. By J. A. Fleming, M.A., D.Sc., F.R.S. New York: E. S. Gorham, 1913. 12mo.; 279 pp.; illustrated. Price, $1.40.

The plethora of cheap works on wireless telegraphy, addressed to non-technical readers, bears witness to the wide-spread interest in this means of communication. Our author condemns many of the popular handbooks on this subject as giving "insufficient explanations of the physical processes involved." The general reader will find this work dealing at greater length and detail with the phases of radiotelegraphy than do the cheap books to which objection is made. It presents theories of the ether, electricity, and electrons, gives the known facts of electric oscillations and waves, describes wireless apparatus and its operation fully, and refers to wireless telephony and the utilization of electromagnetic waves. Pictorial illustrations are not spared wherever their inclusion is necessary to a quick grasp of principles.

MECHANICS FOR BUILDERS. Part I. By Edward L. Bates and Frederick Charles: worth. Longmans, Green & Co., 1913. 12mo.; 201 pp.; with diagrams. Price, $1 net.

Students of building construction who desire to perfect themselves in the principles of form and design are generally required to wade through the whole subject of applied mechanics. This textbook selects from the larger study such subjects as bear directly upon building problems. Volume 1 presents a first-year course of great flexibility, in which is given a thorough grounding in strength of materials and theory of structure.

PRACTICAL HAND BOOK OF GAS, OIL, AND STEAM ENGINES. Stationary, Marine, Traction. By John B. Rathbun. Chicago: Charles C. Thompson Company, 1913. 8vo.; 370 pp.; illustrated. Price, silk cloth, $1; flexible leather, $1.50.

The work exhibits a thorough knowledge and an ability to so express the knowledge as to make it available for the layman. It deals with the construction, operation, and repair of all kinds of engines, with the various parts in detail, and with the different kinds of fuel.

THE AUTOMOBILE BLUE BOOK. 1913. Volume II. New England and Maritime Provinces. New York: The Automobile Blue Book Publishing Company. Cloth; 5¼ x 9⅜ inches; 1100 pp.; with several maps. Price, $2.50.

This handy guide, or touring handbook, hardly needs an introduction. Covering the motor routes of the New England section and the Atlantic Provinces of Canada, with connecting extensions into adjoining states and provinces, with the care, detail and completeness that have characterize this work in the past, the book should most certainly be included as part of the equipment of all autoists. The sections have been systematically arranged for the convenience of the user and the routes shown in graphic detail on the large index map. At the beginning of each route the principal points of interest along the way are outlined. Coupled with this, is a complete and comprehensive index covering over 20 pages, that makes the matter of locating a city or town a very simple thing.

BEYOND THE ATOM. By John Cox, M.A. Cambridge: At the University Press. New York: G. P. Putnam's Sons, 1913.

Here we have a popular account of the new theories of matter written by a man who has been associated with Prof. Rutherford, and has therefore been privileged to witness at close quarters and discuss from day to day discoveries which have radically changed scientific conceptions within the last decade. Mr. Cox begins by introducing us to the atom in the seventies, but before contrasting it with the new atom, he discloses the mechanism whereby the new atom was discovered and its phenomena studied. Hence we find chapters on the vacuum tube, the new rays, the new substances, disintegration, the objective reality of molecules, before the new conception of matter is really presented. The book may be strongly recommended as a trustworthy and simple presentation of one of the most wonderful series of investigations to be found in the whole history of science.

PRACTICAL PATTERN MAKING. By F. W. Garros. Second edition, revised and enlarged. New York: The Norman W. Henley Publishing Company, 1913. Price, $2.

This is the second edition of a very useful book written by a pattern-maker of thirty years experience. He describes not merely the principles of pattern making, but also the materials and tools required in this most important art. A valuable portion of the book is to be found in the illustrated examples of pattern work in wood, of metal pattern work and plate work, vibrator and stripping plates. Specific instructions for plaster work are also given.

A SURVEY OF THE WOMAN PROBLEM. By Rosa Mayreder. New York: George H. Doran & Co., 1913.

Rosa Mayreder's book attracted widespread attention throughout the German Empire soon after its appearance. Written by a forceful woman in a forceful style, it is here presented to the reader in an excellent translation by Mr. Herman Scheffauer. The woman problem is considered from the economic, social and ethical-psychological standpoint. It must be confessed that the author makes the most of the present rather confused status of sex psychology. She places in sharp contrast the diametrically opposed views on the intellectual and emotional capacity of woman uttered by the most distinguished men in history—a very effective weapon. She takes rather too seriously, however, the utterances of Lombroso and Weininger and similar men whose scientific pretensions have long since been riddled. In these days of feminism, equal suffrage and the general movement on behalf of women, a book such as that of Rosa Mayreder should be welcomed. It is polemic, but eminently sane.

DIE WASSERDRACHEN. Ein Beitrag zur baulichen Entwicklung der Flugmaschine von Joseph Hofmann, Preussischer Regierungsbaumeister und Kaiserlicher Regierungsrat a D. in Genf. (Luftfahrtzeugbau und -Führung, Bd. XIV.) VI und 82 Seiten 8°. Mit 57 Abbildungen im Text und 2 Tafeln. Munich: Oldenbourg, 1913.

In this book Mr. Hofmann, one of the pioneers in aerial navigation in Germany, discusses the problems of the hydro-aeroplane in a way that will be appreciated at its true worth by the student of heavier-than-air flight. While the discussion is essentially mathematical, the mathematics are of a simple algebraic kind that anyone who has passed through a high school can easily understand. The book is by far the best treatise on the designing and flying of a hydro-aeroplane under various conditions that we have thus far seen. It constitutes one of the series of excellent handbooks on aerial navigation edited by Capt. Neumann.

LEITFADEN DER DRAHTLOSEN TELEGRAPHIE FUR DIE LUFTFAHRT von Max Dieckmann, Privatdozent für reine und angewandte Physik an der Technischen Hochschule München. (Luftfahrtzeugbau und -Führung Bd. XIII.) X u. 214 Seiten 8° mit 150 Textabbildungen. Munich: Oldenbourg, 1913.

The author of a simply worded book on so highly technical a subject as wireless telegraphy finds himself in an awkward position. He cannot take anything for granted, for which reason he must explain at considerable length conceptions and terms which form part of the elementary intellectual equipment of every wireless operator. Accordingly, the author of this book was constrained to discuss in his introductory chapters the atomistic conception of electricity, direct currents, closed and open oscillatory circuits, radiation, etc. This he has done with rare lucidity, with the result that the following portions of his book, which deal properly with wireless telegraphy and its application to the aeroplane, should be thoroughly understandable by any educated person.

ACCOUNTING. Practice and Procedure. By Arthur Lowes Dickinson, M.A. New York: The Ronald Press Company, 1914. 8vo.; 315 pp.

Accounting is a highly important concomitant of business—particularly of big business. Yet, as the author points out, as a profession it is at a disadvantage in comparison with that of law, since its often momentous decisions are arrived at privately, and the world at large never hears of its solutions. After devoting a chapter to bookkeeping, the succeeding seven chapters take up the income account and the balance sheet. Later we consider some problems in cost accounting, and finally the responsibilities of the public accountant are dealt with. An appendix contains sections of the English laws relating to auditing, consolidation, prospectuses, etc., and the form of balance sheet statement prescribed by the Interstate Commerce Commission for steam roads. The New York form for the annual statements of life insurance companies is also given.

COAL. Its Origin, Method of Working, and Preparation for Market. By Francis H. Wilson, M. Inst. M.E. New York Isaac Pitman & Sons. 8vo.; 129 pp.; illustrated. Price, 75 cents.

Navigating Lights for the Panama Canal

(Concluded from page 200.)

portant light stations as the Ambrose channel to New York and the Delaware River channel to Philadelphia. As the light burns continuously, it is true that considerable gas is wasted, but the cost of the gas wasted during daylight hours is insignificant compared with the pay of an attendant; and, besides, these buoys are often placed on dangerous shoals and reefs which are unapproachable except in calm weather.

Mr. Dalen has also invented a valve used in the A. G. A. system, operated by sunlight for automatically turning the gas off during bright hours and turning it on again in fog and darkness, but so far it has not been practicable to install these sunvalves on buoys. On stationary light towers, however, they have proven a decided success. That the sunvalve is not affected by the temperature of the air is demonstrated by the fact that the Lighthouse Bureau has installed them on lights in the icy waters of northern Alaska and in the tropical seas of Hawaii and the Philippines with equal success. Its construction and operation are based upon the well-known physical law, that a dull dark surface will absorb more heat when exposed to light than one with a bright and shining surface. The Dalen sunvalve shown in section in Fig. 5 comprises a base having gas inlet and outlet passages, an upper dial plate supported by posts on the base and a disk slidable on the posts and pressed downward by a coil spring between the plate and disk, upon three outer rods mounted in the base and a central cylinder. The outer rods are of copper and have a surface of polished gold so as to reflect as much of the light as possible, while the cylinder, which is also of copper, has its surface covered with lampblack, in order that it may absorb the maximum amount of light. This cylinder at the bottom rests on a valve controlling the gas inlet, and at its top it bears against a screw in the dial plate. By manipulating this screw, the sensitiveness of the device can be adjusted to any desired degree. The spring shown inside the cylinder is for varying the coefficient of expansion of the cylinder. The whole device is inclosed in a glass cylinder to protect the parts from the weather.

The operation of the device is as follows: Changes in the temperature of the air will affect the rods and the cylinder alike, for they are of the same metal, but in daylight the polished surfaces of the rods will reflect the light and hence will absorb practically no heat. Meanwhile, the blackened surface of the cylinder will enable it to readily absorb heat which will cause it to lengthen and thus force the valve down on its seat and shut off the light. When darkness or fog comes on, the cylinder and rods again assume the same temperature, and as the cylinder again shortens, the pressure on the valve plate is relieved, permitting a small spring on the end of the plate to open the valve.

On the canal, the sunvalve will be used both with the constant flame lights and also with the flasher. Fig. 6 shows a light equipped with the flasher and sunvalve. In this arrangement the sunvalve will be interposed in the gas conduit between the governor and the flashing mechanism. As in the buoy lights, a pilot flame fed by a pipe direct from the governor must be employed.

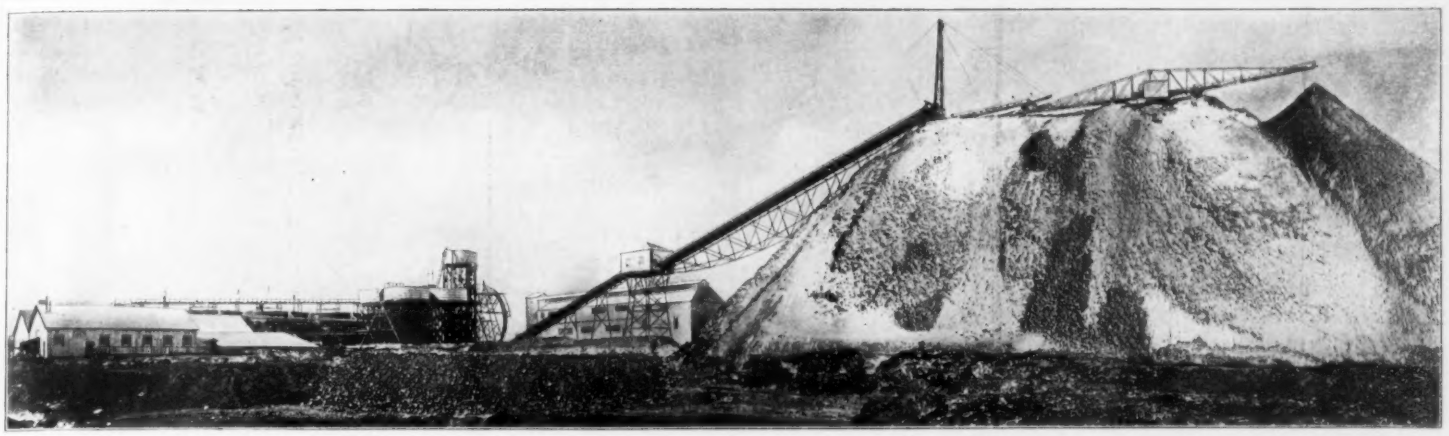
For the whole canal and its entrances, about fifty light buoys and about ninety beacon towers, range lights, etc., will be installed, and this should be sufficient to insure safe navigation at all times.

How the Locks of the Panama Canal are Operated

(Concluded from page 205)

these devices in incorrect sequence; for instance, opening a gate when the chain fender is not in position or when the valves are open, etc.

There is also an interlocking combination that is used in connection with the intermediate gates which divide the locks into short sections. This arrangement is fitted with a Yale lock and key, so that the intermediate gates can be used only



KLEINFONTEIN MINE, JOHANNESBURG, SOUTH AFRICA

This gold mill is equipped with Rubber Conveying Belts aggregating one mile in length and in constant and satisfactory operation for 12 years. There are four sorting belts 36 inches in width on 100-foot centers, and 24-inch conveyors on which the crushers discharge 260 tons of 3-inch and smaller ore every hour. The total capacity of belts in the mill is 2000 tons a day. In addition, there are waste material belts 36 inches wide, conveying waste rock, ashes, cyanide and sand to the dump pile. These discharge from one to the other and run over steel trestles, mast and boom and cantilever structures, moving 2800 tons per ten hours. Other important installations of this type of conveying belt include the Lackawanna Steel Co., Buffalo; Edison Portland Cement Co., Stewartsville, N. J.; Crescent Sand & Gravel Co., Port Washington, L. I.; Solvay Process Co., Syracuse; Camden Coal & Coke Co., Philadelphia; Crane Valve Co., Bridgeport; Chase Rolling Mill Co., Waterbury, and hundreds of others.

Helping the Engineer Solve a Difficult Problem

The mining or mechanical engineer has many important problems to solve. Their accurate solutions are vital to his success.

Some of these problems are intricate and involved. In dealing with them the engineer finds that he saves time and labor, and doubly insures the accuracy of his results and the permanent utility of his work, if he calls to his aid specialists who have made a life study of some one branch or phase of engineering.

Connected with this company are members of the American Society of Mechanical Engineers and graduates of leading mechanical schools, who, in addition to their general technical training, have spent many years in the study of rubber from an engineering and scientific standpoint.

Their researches and experiments have not only resulted in the invention and improvement of various types of rubber belting, both transmission and conveying, but in the acquirement of a vast fund of specialized information which is invaluable to the mining and mechanical engineer.

This information is not a factory secret, except as to the formulae of our products. An important part of our work is educational. Members of our staff regularly prepare papers and lectures, illustrated and otherwise, for the benefit of technical schools, colleges, etc.

We are equally glad to give time and thought to the problems of the engineer. From the records of our large operations and our laboratory experiments, we can furnish many important facts and suggestions, and we are always pleased to be given the opportunity to do so.

Lamina Conveying Belt

This belt differs from other types of conveyor belt in a most important structural detail.

Its plies are laminated and independent.

In a belt folded from one piece of fabric, each ply is affected by the wearing out of the first ply. Thus it often happens that when the surface wears out, the entire belt weakens and goes to pieces.

Not so with Lamina Belt. If the surface wears away and is entirely eliminated, the rest of the belt remains intact. The wear simply devolves upon the next ply, and so on, from ply to ply, abrading the belt by degrees, and thus greatly prolonging its life and usefulness.

It needs no extended argument to prove to the engineer that this type of construction is scientifically correct. It is sufficient to say that in hundreds of important installations, many of them of the most exacting nature, Lamina Conveying Belt has absolutely proved its superiority by giving a greater moving capacity and a longer endurance run, with less trouble and less repair than any other type of conveying belt in use.

Extensive conveying installations run heavily into money.

In the end Lamina Belt will save a handsome percentage of that money. The proof is at your disposal.

Have you undertaken the installation of a conveyor to move any kind of material, such as ore, coal, grain, phosphate, stone, cyanide, sand or cement?

If so, write us, stating the conditions and requirements fully. We can save you time and labor and help you to attain the highest degree of efficiency in the finished installation.

Are you thoroughly informed as to the rapid strides recently made in the improvement of rubber belts and their proved superiority under all kinds of adverse conditions? Have you at hand exact, authoritative information as to the construction of rubber belts; the proper selection of duck; the correct principles of friction; the proper methods of handling and repairing; the correct manner of figuring requirements, dimensions, etc.? These, and other topics, are fully covered in a useful booklet entitled, "A Little Story of Rubber Belts." Send today for a copy of this book—it is free.

The Manhattan Rubber Mfg. Co.

PASSAIC, N. J.

BRANCHES IN ALL PRINCIPAL CITIES

Condor BELT

Have you a mill to belt for power?

If so, you need Condor Belting. It is the most expensive rubber belt made. It is costly because of the labor and materials which are put into it, and economical because of the service it gives.

Condor is the last word in heavy duty transmission belting. In the quality and treatment of the rubber; in the selection and tests of the duck; in the scientific application of the friction, Condor stands in a class by itself.

It is sold under the most sweeping guarantee ever placed behind a belt—a guarantee of more service or a new belt.

Condor is meeting with a constantly increasing and unprecedented success. In mills of all kinds it sets new records in belt utility.

Let us know what your power belt problems are.

when the attendant has unlocked the combination, this also being subject to the general interlocking system. Certain valves are used to cross fill between locks. These also are interlocked, so that they can be operated only in proper order and combination to equalize the water between a pair of locks and save water which would otherwise be wasted. This cross filling consists in allowing water from one lock which is full to flow into a lock by its side in the other channel until the level of the water is the same in both locks, thus using a portion of the water over again.

The fact that the control board is a working miniature of the lock which it operates shows the operator the actual condition of gates, height of water, etc., and, consequently, having the whole condition in miniature under his eye he knows what to do next and when to do it; the operator receiving his information as to the movement of the vessel from a towing master.

How a Vessel is Locked Through.

Let us now take a vessel through a set of locks: It proceeds into the lock forebay either under its own power or that of a tug, and comes to a full stop. It then proceeds under the power and control of four electric locomotives—two forward to take it along, one on each side, and two others astern, one on each side, to keep the vessel in the middle of the waterway and to stop it when it has reached the proper point, and to prevent it from moving forward too rapidly.

After the vessel comes to a full stop in the forebay its position is given by the towing master to the switchboard attendant who, by moving a control switch lever, causes the lowering of the fender chain and the miniature fender chain on the control board after the lock gate is in the proper position.

Now the vessel advances into the lock by means of the electric locomotives. The fender chain is raised and then the massive gates are shut behind, the miniature control board gates in the meantime indicating this movement. When the water on opposite sides of the gates in front of the vessel has been raised or lowered, as the case may be, until the water on both sides is at the same level, as shown on the water level indicators on the control board, these gates are opened and the boat is pulled into the next compartment.

The Molecular Air Pump

(Concluded from page 208.)

second groove connects with the suction of a third groove whose pressure opening communicates with another suction opening and so on, the grooves being in series and the effect being cumulative. The pressure is lowest in the central groove and increases uniformly toward both ends of the cylinder up to the pressure produced by the rough pump. The last is connected by a rubber tube to the nozzle *T* which communicates with the interior of the casing *B*. The bearings of the shaft are oil-sealed, and the oil is prevented from penetrating into the casing by a spiral groove cut into the shaft which forces the oil outward against the atmospheric pressure whenever the shaft rotates. The spiral grooves act only when the shaft rotates with a certain speed, and it is therefore necessary in starting the pump to take care that the rough pump is not connected with the molecular pump until the latter has attained its full speed. On stopping the pump air must be admitted into it before stopping the driving motor. Fig. 5 shows the pump mounted on a common base with an electric motor of ⅓ horsepower which runs at 3,000 revolutions per minute. The pump is geared to the motor by a belt and runs at 8,000 to 12,000 revolutions per minute. The starting switch of the motor and the stopcock leading to the rough pump lock each other automatically so that a mistake in starting and stopping the pump cannot be made. As the new molecular pump acts directly by the motion of the molecules, it can be expected that it will remove not only the gases but also the vapors. This was shown to be the case in an experiment which was made to test the efficiency of the new plant

as the result was obtained without the use of phosphoric anhydride or any other drying agent. The experiment consists in connecting to the pump a Roentgen tube of about 1 liter capacity. In about 10 seconds, starting with a pressure of 5 millimeters, the tube was evacuated to such a degree that sparks were formed in a gap of 15 centimeters connected in parallel with the tube. As a similar vacuum cannot be obtained in less than 100 seconds with the mercury pump, also designed by Dr. Gaede, it will be seen that the efficiency of the new pump is extraordinarily high. It has been found that whereas a pressure of 0.00001 millimeter of mercury is reached with Dr. Gaede's mercury pump in an average in 15 minutes, the same result is obtained with the molecular pump in 4 minutes, and this without the use of any drying agent.

Notes for Inventors

A Combination Condiment Holder.—Stanislaw I. Roclawski, of New York City, has secured a patent No. 1,070,535, for a condiment holder which includes two containers spaced slightly apart at their upper perforated ends with cut off means for controlling the discharge from their respective containers, the cut off means being connected for joint movement and having a part in the space between the container so that it can be operated by the finger of the user when the holder is grasped for use.

Life-Saving Appliance for Coal Mines.—Consul H. D. Van Sant of Dunfermline, Scotland, tells of an invention that is attracting attention among the coal miners of the Dunfermline district, being designed for the saving of lives in the event of a cage rope breaking in the mine pit. The invention includes two extra chains coming from the base of the rope and running down the side of the cage and fastening to four pieces of strong wood that project from the four bottom corners of the cage. When the weight of the cage is on these chains the wood pieces are drawn inside the framework of the cage, but when the weight is off, as when the rope breaks, the wood pieces project by means of springs and engage the bunting and bring the cage to a standstill.

Convict Ingenuity.—Convicts in close confinement and under what is regarded as very strict supervision, constantly surprise the public by the skill with which they avoid the authorities. We recall reading of a convict in the Tennessee State prison who was carrying on counterfeiting operations until the plaster-of-Paris molds were found, and it developed that he had succeeded in melting the baser metal by means of a wire connected up with the electric light wiring in his cell.

A Typewriter for Writing Bengali, an adaptation of an American machine already extensively used in India, is described in a recent consular report. The same typewriter had previously been adapted to writing seven Indian vernacular languages. The Bengali alphabet contains 360 characters, but many of these are identical with others in some of their parts. The actual number of characters engraved on the type blocks of the machine is only 92; these can be variously combined, with the aid of "dead," or non-carriage-operating keys and back-spacers, so that any letter in the alphabet can be produced. Apparently the adaptation cannot be applied to machines having a type guide, whereby the printing point is restricted within defined limits, or to shuttle or type-wheel machines.

Recording the Course of Enemy's Ship.—A patent, No. 1,084,907, has been issued to Francesco Spalazzi, a lieutenant in the Italian Royal Navy, for an apparatus for automatically and contemporaneously recording the course of the ship on which it is mounted, and of an enemy's ship. The apparatus during the travel of the ship on which it is mounted records automatically its course upon a drawing sheet or even directly on a sea chart and at the same time on the same sheet, and at the same scale it records the course of an enemy's ship, the evolutions and position of which are thus continuously registered and immediately made apparent.

Legal Notes

Delays in Prosecuting Patent Application.—In the case of *ex parte* Thomas wherein it was sought to revive an abandoned application, the Commissioner of Patents in granting the petition called attention to the fact that the response to the official action which the Examiner held was insufficient was filed in the Patent Office more than a month before the expiration of the year and said, "One who waits until about the last day to file a response does so at his own risk, but where the amendment is filed in ample time the applicant is entitled to some consideration."

What is Distinctive Name Writing?—In the case of Flanders & Flanders Manufacturing Company vs. Studebaker Corporation, Assistant Commissioner Frazier has held that the word "Flanders" written with a slight peculiarity in the letters with a paraph thereunder and with the upper end of the F extending in a long flourish thereover, is not written in such a distinctive and peculiar manner as to make the name registrable as a trade-mark, and quotes the decision *ex parte* C. H. Allen Company, saying "the distinctive manner in which the name is displayed must be of a character as to give such a distinctive impression to the eye of an ordinary observer as to outweigh the significance of a mere name."

Important Preliminary To Interference Declaration.—Following an order of the Commissioner of Patents, it is now proposed that preliminary to the declaration of an interference, the files of the interfering parties shall be submitted to the law clerk of the Patent Office for a final review, in order that his judgment may aid in determining whether the interference shall be declared. This is important, as it may avoid the declaration of interference in many cases where the interference should not be instituted, which cases frequently result in no benefit to either party and considerable expense to both.

Division of Re-issue Applications.—The new Commissioner of Patents, Mr. Ewing, early in his administration, indicated his intention of not blindly following precedents. In the case of *ex parte* Van Nostrand, he overruled a decision of many years standing, and held that where an application is filed for the re-issue of a patent, division cannot be required. In his decision, the Commissioner said, "the issuance of a re-issue patent is not the granting of a patent, but the exercise of the privilege of correcting a patent already granted, for which the law provides a fee different from the fee required originally, and I find no authority for requiring the applicant to pay more."

Some Adjudicated Patents.—The Colman patent No. 672,636 for a Knotting Machine has been held valid and infringed in Byrd Manufacturing Company vs. Colman; the Hall patent No. 692,277 for an Incubator as limited by the prior art and the specific language of the claim has been held not infringed in Hall, Mammoth Incubator Company vs. Teabout; the Smith patent No. 692,935 for weft-replenishing mechanism for looms, as to claims 13 and 14 has been held void for lack of patentable novelty in view of the prior Northrop patent No. 600,016, in Crompton & Knowles Loom Works vs. Stafford Co.; the Colman patent No. 755,110 for a knotting machine has been held valid and infringed in Byrd Manufacturing Company v. Colman; claims 2, 3 and 7 of the Keyes' patent No. 923,534 for an improvement in neckwear have been held void and claim 1 valid and infringed in Slip Scarf Company v. Blanchard & Price; claims 1 and 2 of the Miller patent No. 1,007,041 for a vehicle seat and lock have been held void for lack of patentable novelty and invention in Biddle v. Hodge & Graves Co. and the Coldwell & Gildard reissue patent No. 11,923 (original No. 637,234) for a warp stop motion for looms has been held void as to claim 19 as not for the same invention disclosed in the original patent and valid and infringed as to claims 23 and 25 in Coldwell-Gildard Co. v. Stafford Co.

The Flying Machine and Its Equipment

A Summary of the Air Navigator's Instruments

BEFORE it really came the flying machine was popularly conceived as a sort of winged bicycle running on air, a machine that could be taken out of the shed like a buggy. But when men actually flew they soon found that flying was far more difficult than was anticipated; that, indeed, it was peculiarly like sailing a ship far from land, because the ground appears very different from an altitude than from a horse and buggy, that the motion is so bewilderingly rapid to the novice that he knows not in what direction he is flying. He must determine his whereabouts in some way and steer a definite course. The direction in which the bow of the machine is pointed has little to do with the direction of actual motion; for the machine follows not only the thrust of the propeller and the rudder, but also the direction of the wind. Again, the wind, at a height may blow in a direction quite different from that indicated by weather vanes, the swaying branches of trees, clouds of dust, fluttering flags, and the smoke from chimneys. Speed and direction of flight can be determined only by experience. Soon the knack is acquired of ascertaining how much speed is due to the motor, how much to the wind.

To steer a definite course is difficult enough even in a motor-boat. It is still more difficult in an aeroplane, requiring as it does close attention and incessant vigilance to keep the machine from capsizing. Much of this work, unfortunately, is done instinctively. After some practice, balancing an aeroplane becomes as much a matter of course and requires as little thought as balancing a bicycle. He performs the necessary motions to keep it from falling absolutely unconsciously.

But a bicycle runs on a stationary support, while the aeroplane glides on an exceedingly unsteady body of air; that is one vital difference. Another is the fact that while the balancing of an aeroplane becomes partly instinctive, still the pilot does not immediately feel whether he is losing his balance, as he would feel if he were skating or running. Sometimes he must reason. Why? Because he can control it only as long as it is speeding ahead. It is very easy to stop all progress of an aeroplane in spite of the motor and propeller simply by guiding it upward too suddenly. An aviator may easily do that, and no instrument will tell him of his danger. Indeed, if an aviator wants to ascend quickly, his instincts urges him to point the nose of his machine up sharply, whereas he should do so very gently if he really wishes to climb.

In making a curve the natural instinct is to bank strongly, to incline the body toward the center of the curve. But an aeroplane banks itself the moment it is turned because of its great span. One side in turning will always describe an essentially greater circle through the air than the other, and naturally moves faster. Therefore, it rises in the air. Hence, instead of helping the banking, the pilot has often to counteract the exaggerated rising tendency of one side. It takes experience to get just the right amount. If there is too much banking the machine does exactly what a bicycle does when banked too much in turning on a wet pavement. In other words, it capsizes and falls toward the center of the turning circle.

Even when control is lost by steering upward there is a parallel in bicycling. After you have pedalled a bicycle up on a steep hill with great exertion, and follow a natural but wrong instinct to relax your efforts when you have reached the level course at the summit of the incline, you are surprised to find that the bicycle has lost all its speed. It almost stops, and you have to thrust out your legs to touch the ground and prevent it from falling. With a flying machine the ground is unfortunately far off, too far off to be reached by an outstretched leg. The aeroplane should really be compared with a bicycle running high on a wire, so that if it falls it falls into space.

In view of all these difficulties, successful cross-country flying is made possible only by instruments which curiously resemble those employed in navigating ships on the perilous ocean. It is obvious that a single flyer cannot make the best possible use of them. He has his hands too full. When it is remembered that a whole staff of navigation officers watch the nautical instruments aboard a ship, we realize how much is expected of the aviator. The navigating problems of the air so greatly exceed those of the water in difficulty that only dirigibles which can carry a whole staff of navigating officers are equal to the task. It becomes evident what an overwhelming advantage the two and three-seated aeroplanes have over the one-seated aeroplane.

The first instrument needed, an instrument never absent in an aeroplane, not even in the school machines that fly only above aviation fields, is a revolution counter for the motor. This is the same as that used on automobiles, and consists of a flexible shaft connected with the motor, a casing containing clockwork and a dial on which a hand travels over figures. Thus the number of revolutions made per minute is indicated. The aeroplanist cannot know how strong is the wind at the level at which he is flying; but the revolution counter sufficiently indicates what speed the machine itself is making to allow him to estimate the proper direction to head his machine.

The same service is performed, but more efficiently by another instrument with which many machines are now equipped, namely, a wind gage that measures directly the actual speed of the machine in the wind. This instrument renders another most valuable service: it shows the pilot when he is losing speed, and with the speed, the control of the machine. Formerly pilots used to depend for this information on the feeling of the wind as it struck their faces.

Similar benefits are derived from two inclinometers—levels that tell the pilot just how much he has inclined his machine fore and aft or from side to side. It has been found that even a trained eye may be deceived about the actual position assumed; that in darkness the pilot loses all judgment, although he may be occasionally guided right in the dark by blind instinct. Unfortunately a fluid level, an air bubble or a pendulum device is subject to many disturbances aboard an aeroplane because of the inertia and momentum of the moving masses. Pilots will eagerly adopt a trustworthy gyroscopic indicator that will fulfill the difficult task of indicating the true horizonal. Once such an instrument is invented flying will become fifty per cent safer, and will be possible even in the dark.

The control of the motor itself requires many instruments. If the aviator is alone, it may indicate only when trouble is coming, and when he should prepare himself for a downward glide, assuming that the faulty motor has not yet lost him his speed and control. If he is not alone his companion should be able to remedy the irregularities indicated by the instruments. As yet designers have given much attention to mounting the motor within easy reach of one of the passengers.

There is not the inevitable steam gage—because the engine is a gasoline motor—but a dial on which the proper circulation of the cooling water is indicated. Another dial shows the working of the lubrication system. There is a switch for throwing in or cutting out the electric ignition. Some machines have also an electric meter showing the strength of the electric current that makes the spark, and guaranteeing, therefore, that the spark is efficient. And there is a pressure gage in every machine that indicates the amount of air pressure in the gasoline tank by which the fuel is forced to the motor.

Most important is, of course, a float or a glass fluid level that shows how much gasoline is in the fuel tanks; without it the motors might suddenly cease to work over a locality where even by a long glide from a great elevation, the pilot could not reach a safe landing place.

High flyers have discovered why birds are so warmly covered with down and

feathers. Flying is a cold sport—as cold if not colder than ice-boating. The stinging blast of the upper air becomes unbearable to a pilot of an aeroplane. Remember he is traveling at a speed of sixty to eighty miles an hour. The warmest clothing has been tried. Still, the cold eats its way through. Pilots reach the ground numb, and apathetic, which perhaps explains some accidents that have happened at the end of long, high flights.

There is no reason why a few tubes connected with the motors should not convey the hot water from the cylinders around the pilot's cockpit. That is possible in European machines; for the barbaric method of seating the pilot in empty air at the edge of the lower plane of biplanes still compulsory in the American Wright and Curtiss machines, has been discarded abroad in favor of well protected cockpits. A heated cockpit could be provided with a windtight cloth cover that buttons to the aviator's dress like an Eskimo's "dojak."

In Austria, Etrich has seated the sorely tried pilots in a completely inclosed limousine of good stream line form, made of mica. Thus, even noxious head resistance is saved; for at sixty to eighty miles an hour, any part of an aviator's body that is exposed to the wind, wastes power.

Some foreign aviators have installed in their machine a little desk on which to write notes and make little sketches. Some French machines in the last Paris show were even equipped with a little locker for food and with heating devices. Such conveniences are particularly reasonable in machines designed for two pilots with double controls so that one man may refresh himself not only with rest, but also with food and drink while the other takes his turn in guiding the machine.

A serviceable device in aeroplanes is the pilot's belt. Aviators like the oarsmen in Venetian galleys must literally be strapped to their seats. At times the wind forces the machine around with a violence that finds no parallel even in a small sailing ship in the heart of a tempest. Caught by the air the machine is hurled down so suddenly (without capsizing or getting out of control) that the inertia of the pilot's body would cause him to fly out of his seat and lose his grip on his levers unless he were held down. In fact, pilots have been pitched out of machines that were still under control and killed. It was then that the French invented the aviator's strap, a strap that holds the body fast and is still a bit elastic, a strip wide, very strong, and capable of being instantly released in case of a smash of the machine.

Flying has developed other safety devices. A life-belt against drowning does not necessarily inspire one with awe because it may be useful in learning to swim. But it is different with a safety helmet that performs its function only after you have fallen head foremost. These helmets consist of fixed padding filled with resilient, coiled, steel wire. They may save a man from a cracked skull, but not from a broken neck.

If not crowned by a helmet, aviators' costumes are usually topped by a sort of skull cap to cleave the wind with the least trouble. A weird barbaric feature of this cap or helmet is to be found in the little roll or screen at the side of the head, right in front of the ears to protect the eardrums somewhat against the terrific clatter of the motor's open exhaust. A muffler would not consume very much power. It has been tried successfully in England, and is, in fact, furnished, if desired, with the newest models of Wright biplanes. To protect the eyes from the icy blast and from flying oil, goggles are worn.

All these instruments and implements deal with the mere function of flying, of keeping afloat in space. To navigate the aeroplane, an embryonic edition of a mariner's navigating instrument is required. The compass is indispensable. Numerous difficulties, connected with its use aboard aeroplanes, have been gradually overcome. The first is the excessive vibration of a frail and small craft—an engine room as it were—with a motor

EPICYCLIC TRAINS, which play an important part in toothed gearing, are ably described in Scientific American Supplement 1524. Price 10 cents. For sale by Munn & Co., Inc., and all newsdealers.

equipment of nearly one fifth the power of that of a mammoth dirigible. Aeroplane compasses are now floated in a liquid contained in a vessel that is supported on a bed of resilient felt-chips. A formidable obstacle to the use of the compass is the mass of iron in the powerful motors, necessarily in close proximity to the magnetic needle. It is no easy task on shipboard to arrange pieces of iron around the compass so that no matter how the ship may turn, and in what position the mass of its hull may be relatively to the needle, the needle will always turn to the north. An aeroplane turns not only around a vertical axis, but also around a horizontal axis when it is inclining. It turns, moreover, more suddenly than a ship. Still the aeroplane compass has been made fairly reliable.

For cross-country flying a map is as necessary as a compass. Maps for aviators are different from other maps. They must not contain too much confusing detail. For quick reading they must emphasize those features which most resemble the general outline and the principal landmarks visible on the ground. They must chart the dangers to the aerial navigator—eminences, such as church towers, factory chimneys, even high trees. All suitable landing places must appear on the map, as well as telegraph wires and high-tension conductors. Very important is the indication of the different levels of the ground. Without that a machine may easily come to grief.

Moisant employed an easy method to hold a definite course with map and compass. He simply picked out some prominent landmark, the tower of a church, for instance, in the general direction of his course, fixed his intended direction on the compass dial and noted the changing position relatively to his chosen mark. When he came too near to the latter he picked out a new one. In the recent flight from Berlin to Vienna an officer guided an aviator, whose passenger and helper he was, even above the clouds, simply by taking his direction from the sun and computing the sun's position by his watch. This presupposes an extraordinary sense of locality. Using the same principle, a compass has been constructed for aviators that is simply a sun dial reversed. As a sun dial will give the time when the points of the compass are known, this instrument, of identical construction, will give the points of the compass if the time is indicated by a perfect chronometer. Astronomical tables showing the changes of the sun's position with the seasons must be consulted. Even finding a place astronomically by taking the sun's height is now taught to German aviator officers, thanks to Prof. Marcuse, who has designed instruments with which these measures may be taken very easily and quickly, by means of an artificial horizon and tables with hardly any figuring. Such methods will be of great benefit to an aeroplane that has completely lost its way above clouds.

It is often of the greatest importance that the aviator should know his altitude above sea level. So, after nautical localizing, he should be able to read his altitude above the ground from his map, which should give ground altitude in order to be absolutely accurate. Thus the aviator is able to keep clear of the ground and its many dangers.

It is always well for the aviator to know his exact altitude. Therefore, he carries a barometer—not the old-fashioned kind with mercury in a long glass tube, but a little contrivance that indicates by clockwork on a dial the deformation of an elastic casing from which the air has been exhausted. Aeroplanes also occasionally carry barographs—the same sort of barometer, but one that automatically registers the changes of altitude during flight on a sheet of paper.

The Wireless Telegraph Station at Punta Arenas, on the Straits of Magellan, is expected to be in full operation early this year. It will be a station of 100 kilowatts, comprising seven tubular steel masts 269 feet high, and costing over $150,000. A provisional installation on two of the masts has already established

communication with the station in the Falkland Islands and with vessels passing through Magellan Straits. A secondary station will be installed at the Evangelistas Lighthouse, at the Pacific entrance to the straits. Navigation through the straits will be greatly facilitated by the new stations.

Recent Advances in the Art of Lacquering

By L. V. Redman, Department of Industrial Chemistry, University of Kansas

THE art of lacquering metal consists in placing a thin transparent film of varnish upon the polished surfaces of metals such as silver, brass, copper or German silver, to serve as a protective coating and prevent the rapid tarnishing of these surfaces by such agents as oxygen, sulphur, acid vapors, and the active reagents in the air, e. g., coal smoke and furnace fumes. Lacquers have consisted generally of natural gums dissolved in suitable solvents to which have been added small amounts of drying, vegetable, oils; these oils serving as agents to toughen and temper the brittleness of the resins and allowing the lacquers to be applied easily and smoothly. The solvents are alcohol, amyl acetate (banana oil) wood spirits, denatured alcohol, ethyl acetate, wood distillates, nitro-benzene, benzol, petroleum spirits and turpentine. The resins, gums or waxes are kauri, gum elemi, soft copals, shellac, ceresin, casein. These resins are very largely replaced by artificial materials such as nitro-cellulose, cellulose acetates, celluloid and cellulose formate.

The oils added to decrease the brittleness consist of linseed, tung oil, and castor oil. Other materials used for this purpose are camphor and glycerine. Recently, that is, within the last four years, there have appeared on the market lacquers of new order. These lacquers are composed entirely of synthetic resins dissolved in the regular lacquer solvents. They contain no oils, no natural resins or gums, and in fact have no natural product of any kind whatsoever in them. The raw materials for these varnishes are very wonderful and the synthetic lacquers stand as a monument to the modern chemist's skill. They consist of carbolic acid, which is obtained from the tar that collects upon the sides of the ovens when coal is being roasted to produce illuminating gas or coke, and formaldehyde, which is produced from wood alcohol by incomplete combustion.

When carbolic acid (or phenol, the general name applied by chemists) and commercial formaldehyde, in equal volumes, are heated together for some time, there results an amber-like resin which, if not heated too long a time or at too elevated a temperature, is soluble in alcohol, amyl acetate, nitro-benzene, aniline, wood distillates, carbolic acid and many other solvents. The reaction between the carbolic acid and formaldehyde may be hastened very much by the introduction into the mixture of such foreign substances as salt, washing soda, acids, alkalies, and salts generally. These foreign substances are added in small amounts and are used for the sole purpose of hastening the reaction. As their rôle is not well understood in the reaction, the chemist is satisfied to say that they act catalytically and the substances are called catalysts, meaning that the reaction is hastened by their presence, although they do not enter directly into the reaction. As the formaldehyde is volatile, the reaction is carried on in closed vessels fitted with reflux condensers, to prevent the escape of the gaseous formaldehyde. After the heating has continued for the desired length of time, generally one hour, the mass is allowed to cool and the gum is taken from the vessel, washed well in water to remove the catalyzer and then dried. The result is a resin not unlike common resin in appearance and possessing many of its physical properties. The resin melts at 80 deg. to 100 deg. Cent. It is rather brittle, dissolves readily in the common solvents, except petroleum products, and when about 20 per cent by weight is dis-

solved in 70 per cent alcohol and 10 per cent amyl acetate, it makes a lacquer which dries very rapidly to a hard lustrous coat.

The article thus coated and dried is subjected to a process of heating for different periods of time, from a few minutes to several hours, depending upon the temperature and the thickness of the coat. The temperature ranges from 125 deg. to 200 deg. Cent. The higher the temperature the more rapid is the transformation. This heating process imparts the most wonderful properties to the lacquer. After the heating it is completely insoluble in all ordinary solvents, and the lacquer may be allowed to stand in alcohol or acetone for weeks at a time without suffering the slightest depreciation. Acids and ammonia have no effect whatsoever upon it, and strong alkalies dissolve it only very slowly.

The lacquer may be applied either with an ordinary brush or air brush, or the article may be dipped in the lacquer. After coating by any of these methods the article is dry in the course of an hour and may be placed in the oven for heating. The baking is generally complete after one hour, and the article is removed from the oven and is ready for the market. Two or more coats may be given to the article if desired before the heating process is begun. Generally two coats are sufficient. Articles thus lacquered are of special value in chemical and medical laboratories to withstand the corrosive fumes of the chemicals. Microscopes, polariscopes, and instruments which are made largely of brass, copper or silver, retain their luster indefinitely when thus coated. The lacquer also has much more extensive uses in the lacquering of brass beds and brass and copper household ware, such as candle-sticks, trays, candelabra, brass urns and all kinds of beaten copper and brass.

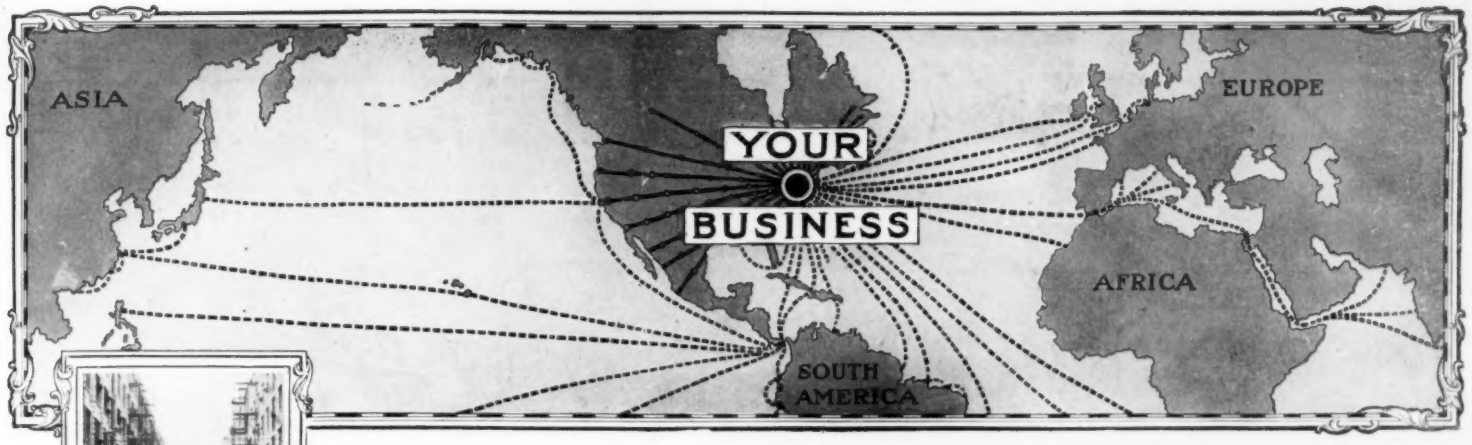
Once the article is properly coated with this lacquer its surface is immune to the attack of solvents and the atmosphere. It may be immersed in alcohol, acetone, dilute acids, alkalies, or washed with hot soap and water, without injury. Ammonia, vinegar, or other solvents likely to be found in the average home has no effect upon it. The lacquer may be injured by the use of such cleansers as contain grit in any form, as the grit actually cuts off the lacquer by erosion. In every other respect the lacquer is permanent. It possesses a durable lustrous surface, is quite transparent and elastic in thin films, and possesses a light golden color which may be made any desired color by the use of the proper dyes or pigments.

Philippine Government Students in the United States

FOR a number of years the Philippine government has been sending young Filipino men and women to the United States to receive a collegiate education with a view to appointment to higher positions in the government service. Up to date 211 of these "pensionados," as they are called, have been sent over, and a large number of these have been appointed to office on graduation. Hereafter a different policy is to be followed, as the islands now have a university of their own, where natives may receive thorough training in all undergraduate subjects. Accordingly, pensionados will only be designated for postgraduate study in the United States. The Philippine legislature, at its last session, provided fifteen fellowships for advanced work at American institutions.

Explorers Using Wireless Telegraphy

THE Italian expedition to the western Himalaya and the Karakorum, under Dr. F. de Filippi, is equipped for wireless telegraphy and is preparing to use this means of determining longitude in its surveys. The outfit has been tested in India, where it was used for time signals between Simla, Delhi and Lahore, and subsequently between Skardu, in Baltistan, and Lahore.



To the Man Who Wants to Get MORE BUSINESS in the East

A recent report of the Census Bureau at Washington classes New York as the "chief center of manufacture for the United States." In New York City there are 28 different lines of business, each one of which produces and sells considerably over $10,000,000 worth of goods per year.

IN one industry alone New York supplies half the total output of the United States. As a financial center New York is more than six times greater than any other city in the country. Twenty-six per cent of the banking power of the United States is centered in New York—and 10 per cent of the banking power of the world.

These are stupendous facts and figures. They emphasize the vast and far-reaching importance of New York as a focusing point for business—as a base from which YOU should operate if you want to increase or develop import or export trade, or if you want more business in the East, with lower selling expense, reduced transportation costs and quicker deliveries.

You should have storage, assembling, shipping or manufacturing quarters in New York—

BECAUSE you would then command the most efficient and complete manufacturing and shipping facilities in the United States.

BECAUSE 27 per cent of the buying population of the United States would be located within 100 miles of your door—a market of tremendous possibilities.

BECAUSE New York is the gateway through which one-half of the import and export business of the United States passes.

BECAUSE in New York you would have a labor supply not to be found in any other American city.

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